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THE ECOLOGICAL ASSOCIATIONS OF THE BUTTERFLIES OF STATEN ISLAND

(Richmond County, New York)

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INTRODUCTION

Although the butterflies of the northeastern United States have been studied and collected for a century and a half, an ecologist trying to use published data on them for the analysis and comparison of faunas is apt to find himself at a loss. Intensive regional faunistic studies are few, and published phenological data are scanty; the best regional documentation is tied up in the unpublished notebooks of long-time resident collectors or dispersed with their collections. The lack of such data was brought home when a regional study of the Delaware Valley was in preparation (Shapiro, 1966); a region collected by Skinner, Aaron, Haimbach, Laurent, and others in the forefront of butterfly study in their time was appallingly documented! The Delaware Valley situation, far from being unique, applies to most of the northeast. General regional surveys are available for the state of New Jersey (Comstock, 1949) and the vicinity of Philadelphia (Skinner and Aaron, 1889) and unusually good data for the District of Columbia (Clark, 1932). More or less detailed studies of specific localities have appeared: the McLean Bogs Reserve (Forbes, 1926) and the Allegany State Park (Saunders, 1932) in upstate New York; the Tinicum Wildlife Preserve near Philadelphia (Shapiro, 1970a); and the Powdermill Nature Reserve in southwestern Pennsylvania (Clench, 1958, 1959, 1960). Some ecological and phenological data can be

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extracted from the many local lists published mostly before 1940 in the *Canadian Entomologist, Entomological News,* etc. (e.g., Bailey, 1877 for Karner, then Center, New York). The documentation for the New York city area is very poor (cf. Beutenmuller, 1893, 1902).

In 1910, William Thompson Davis published "A List of the Macrolepidoptera of Staten Island, New York," with copious natural history annotations on the butterflies. Davis was an all-around, self-taught naturalist, an indefatigable observer and a stimulating teacher whose influence on Staten Island remains strong twenty-five years after his death. His interest in the butterflies was later supplanted by other specialties, but in those early years he set down on record a vivid picture of the Island and its fauna which allows for comparison with conditions sixty-odd years later.

Until very recently, Staten Island remained relatively undeveloped in the literal shadow of New York City. The building of the Verrazzano-Narrows Bridge, linking the Island to Brooklyn, has ended its isolation and probably doomed its natural features to submergence by asphalt and concrete. Despite its underdevelopedness and proximity to the city, the Island received virtually no attention from Lepidopterists after Davis' active years. Yet Staten Island is of special interest for several reasons: its great geological and botanical diversity within a small area; its location near the northern extremity of the Atlantic coastal plain corridor; its sharing of biotic elements with the distinctive Pine Barrens of southern New Jersey and central Long Island; and the changes and stresses brought on its biota by the work of man. Like the Philadelphia area, Staten Island is geographically strategic in bringing together species from different biomes and hence has a very high species diversity. Cognizant of the need to document this situation before it is obliterated by advancing urbanization, we initiated an ecological survey of the butterflies of Staten Island in the summer of 1970 and continued it through the 1971 season.

Characteristic of the Atlantic seaboard climate is its high interseasonal variance in virtually any property measured. The year 1971 proved to be an extreme one even in a climate of extremes, casting some doubt on the validity of our phenological observations. The nature of the 1971 deviations and their impact on the biology of butterflies are discussed in Appendix II.

Geography and Topography

Staten Island is coextensive with Richmond County, New York, and the Borough of Richmond of the City of New York. It is located between latitude 40°29′ - 40°39′ north and longitude 74°3′-74°16′ west, opposite the mouths of the Hudson, Hackensack, Passaic and Raritan Rivers. The Island forms an irregular triangle covering some 70 square miles with maximum dimensions 13 miles (NE-SW) by 7¾ miles (NW-SE). The Island is shown in full on the United States Geological Survey 15-minute quadrangle, "Staten Island New York-New Jersey," (1955) and on the 7.5-minute quadrangles "Elizabeth," "Jersey City," "Arthur Kill," and "The Narrows."

The following summary of the topography of Staten Island is from Glazer (1938):

> The most marked topographic feature is a central ridge having a fairly uniform range of elevation. It extends in a northeast-southwest direction, from New Brighton to Richmond. To the south, the ridge curves sharply westward and sinks rather suddenly beneath the inundated expanse of Fresh Kills meadows.
>
> The elevation forms a broad belt whose area is approximately 14 square miles. The eastern and southeastern sides are rather sharply defined by an abrupt escarpment, at the foot of which lies a coastal plain extending from lower (New York) and Raritan Bays. The western flanks, on the other hand, are more gently inclined and their outlines are softened beneath a mantle of glacial drift. This gentler inclination may well be due to the low dip of Triassic strata, which boring logs . . . show to have extended at one time to higher altitudes on the west side of the Island.
>
> Upon the ridge as a base there is superimposed a cover of later formations. These widen the Island and prolong the ridge topography to Tottenville at the southern end. The hills attain a greater elevation than is found elsewhere along the shores of the Atlantic from Maine to Florida (the highest being Todt Hill at Ocean Terrace, 413 feet).

Geology

The "backbone" of Staten Island is composed of a massive body of serpentine rock of great but uncertain age. This material outcrops naturally in various places, including the tops of the highest hills, and has recently been exposed by excavations elsewhere. The character of the serpentine at the surface varies greatly from place to place. Being chemically unstable and liable to rapid weathering, especially by acids, it breaks down to a variety of materials, depending on the chemistry and exposure of the rock. (This process has been greatly facilitated by sulphur oxides and sulphuric acid in the air and rain water due to pollution.) The decay products include fibrous serpentine (chrysolite, "asbestos"), talc, and miscellaneous complex

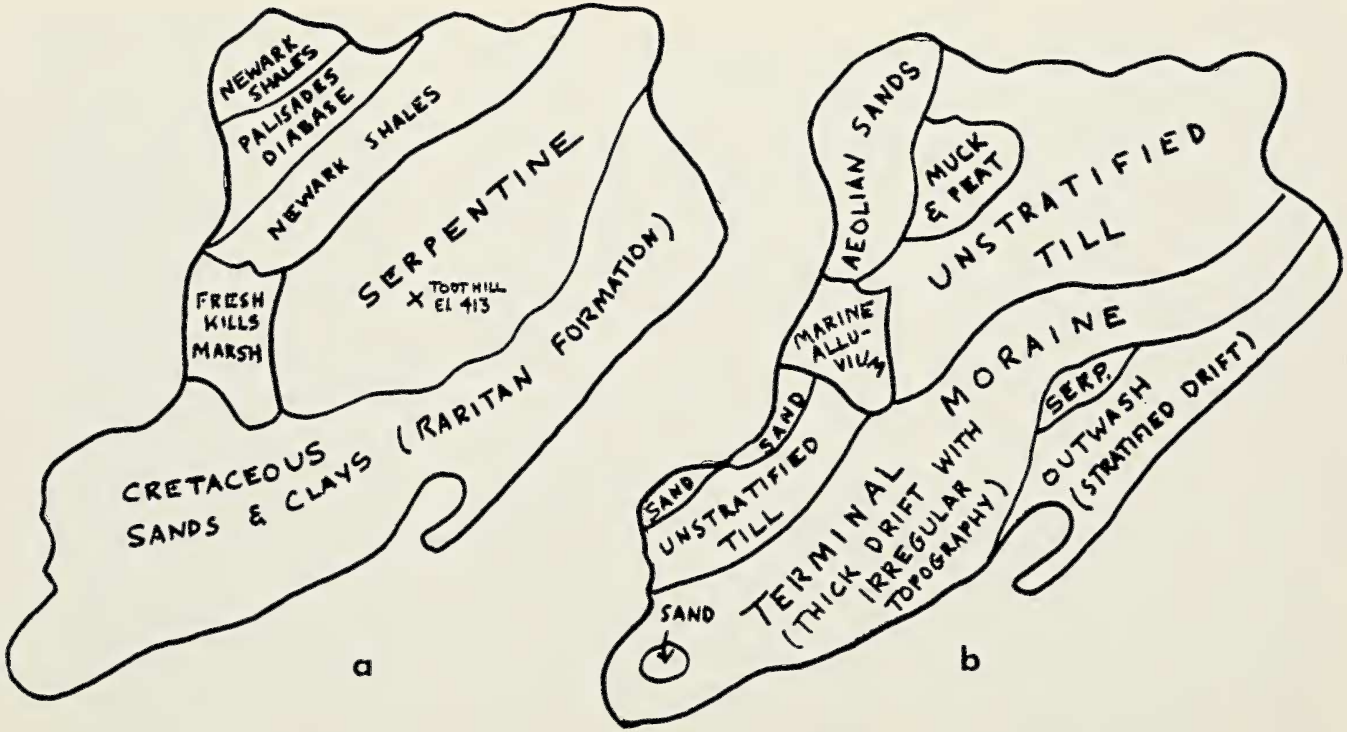

Fig. 1. Maps of Staten Island showing historical (a) and surficial (b) geology.

carbonates. Associated with the serpentine in some locations are substantial amounts of limonite (bog iron ore), either in place at the surface of weathered serpentine or in the form of botryoidal masses, concretions ("puddingstone"), or massive nuggets frequently studded with quartz crystals.

Northwest of the serpentine-limonite mass, from Port Richmond to the Fresh Kills, is an area of low Triassic red shales of the Newark series, continuous across the Arthur Kill. Intruded through this is the most southerly outcrop of the Palisades diabase sill, with a large exposure in Mariner's Harbor ("Graniteville") and a smaller one at Travis. The diabase takes the form of a long, low hill trending northeast-southwest, roughly parallel to the serpentine ridge.

The southernmost third of the Island, south of the serpentine and east of the escarpment, is composed of plastic clays, sands and gravels of Cretaceous age, covering some 28½ square miles. Interstratified with them are local beds of poorly consolidated limonitic conglomerates.

The bedrock of the entire New York metropolitan region, the Manhattan formation of highly metamorphosed schists and granite pegmatites, does not outcrop anywhere on Staten Island although borings show that it underlies the Triassic and Cretaceous formations. The depth of the serpentine and the nature of its contact with the schist are poorly known.

All of the older formations on Staten Island are more or less concealed by Pleistocene and post-Pleistocene deposits. The Wisconsin glacier extended south to the serpentine escarpment, forming a terminal moraine covering the northeast corner of the Island and thence southwestward roughly along the escarpment, reaching Raritan Bay at Seguine Point. The thickness of the moraine is very variable, but it covers the serpentine to a greater or lesser degree, with only a small pocket at Dongan Hills unglaciated. North and west of the terminal moraine, the underlying formations are concealed by more or less unstratified drift, including a substantial number of erratics. Deep yellow and gray sands occur on the west shore at Arlington, Chelsea, Bloomfield, and Woodrow. These are partly of glacial origin and partly dune sands; they and the organic peat of the Fresh Kills marshes completely obscure the Cretaceous clays on the west shore except where excavations or erosion have exposed them locally. Southeast of the terminal moraine, the Cretaceous clays are buried under a thin outwash plain of sand and fine gravel.

Present Vegetation

As of 1971, between 1/3 and 1/2 of the land area of Staten Island could be classified as "developed," and the remaining area has all been strongly modified by man. The natural vegetation resulting from man's activities depends largely on the surficial geology as discussed above. All of the Island has been logged, cleared, or burned repeatedly since the earliest European settlement in the mid 17th century, and no "virgin forest" has existed for over a century. The oldest significant tracts of woodland are 60-80 years old. Such agriculture as existed on the Island expired within the last 30 years, leaving old fields to their successional fate. Old residential communities on the west shore have been nearly obliterated by brush since they were abandoned.

Staten Island lies within an area of oak-hickory climatic climax (Shelford, 1963) and the oldest woods on the Island are approaching this condition. The character of the climax vegetation varies, depending on soils. The peculiar chemistry of serpentine results in generally stunted vegetation of low species diversity, with a high percentage of edaphic endemism. The presence of moraine overlying the Staten Island serpentine has improved the soils so that the serpentine-barrens formation is much less well developed than on the unglaciated serpentines of southeastern Pennsylvania. The earlier Staten Island botanists found many of the serpentine endemics, such as *Clematis ochroleuca,* on the poorest soils (especially on Todt Hill). Increased fire frequency with the coming of civilization has probably led to their disappearance. Today, the serpentine soils support a fire disclimax dominated by little bluestem, *Andropogon scoparius,* often to the exclusion of nearly all other plants (fig. 2); switchgrass, *Panicum virgatum,* replaces it in wet areas. There are scattered clumps of sprouting black cherry (*Prunus serotina*) and gray birch (*Betula populifolia*) and of bayberry (*Myrica cerifera*) and winged sumac (*Rhus copallina*). Associated herbs include silverrod (*Solidago bicolor*), gray goldenrod (*S. nemoralis*), and white thoroughwort (*Eupatorium album*); lichens (*Cladonia* spp.) and mosses, especially silver moss (*Bryum argenteum*) are common and in many places are the only plants found with little bluestem.

Where fire has been excluded and a mature forest has developed (especially on heavy moraine, as on parts of Todt and Emerson Hills), the dominant species are red, black, white and

chestnut oaks (*Quercus rubra, velutina, alba,* and *prinus*), with an understory of maple-leaf viburnum (*Viburnum acerifolium*), lowbush blueberries (*Vaccinium* spp.), aster (*Aster cordifolius*), haircap moss (*Polytrichum commune*), etc. This is the only upland forest on Staten Island; although on serpentine it is actually somewhat richer than the second growth on granite and diabase overlooking the Hudson Valley farther north. The understory of most of the upland forest has been damaged by use for camping, scout training, etc. but is recovering in protected areas.

The lowland forests, particularly well developed in Mariner's Harbor and Willowbrook in the north and Annadale-Huguenot in the south, are on sandy soils but have a thick peaty surficial layer of poorly decomposed leaf litter. The dominants are pin, swamp white, and basket oaks (*Quercus palustris, bicolor, michauxii*), sweet gum (*Liquidambar styraciflua*) and black gum (*Nyssa sylvatica*). The shrub layer generally includes spicebush (*Lindera benzoin*), arrowwood (*Viburnum dentatum*), and highbush blueberries, while the understory has extensive areas of cinnamon and royal ferns (*Osmunda cinna momea, O. regalis*), sensitive and dotted chain ferns (*Onoclea sensibilis, Woodwardia areolata*), and such spring wildflowers as Canada mayflower (*Maianthemum canadense*), troutlily (*Erythronium americanus*), and skunk cabbage (*Symplocarpus foetidus*).

The sands of the west shore are highly acid and formerly supported a Pine Barrens vegetation. This area has been subject to very frequent burning and many of the Pine Barrens endemics, like those of the serpentine, have been lost. Only a few—less than two dozen—native pitch and Virginia pines (*Pinus rigida, P. virginiana*) remain. The dry upland sands support a nearly impenetrable scrub overgrown with greenbrier (*Smilax* spp.). The main woody species are blackjack, scrub, and post oaks (*Quercus marilandica, ilicifolia, stellata*), gray birch, highbush and lowbush blueberries, sheep laurel (*Kalmia angustifolia*), and sweet pepperbush (*Clethra alnifolia*); in wetter spots chokeberry (*Aronia melanocarpa*) is very abundant (Figs. 3, 6). Some common herbaceous associates are fragrant goldenrod (*Solidago odora*), false indigo (*Baptisia tinctoria*), broomsedge (*Andropogon virginicus*), and on wet sites, bunchtop bluestem (*Andropogon glomeratus*) and switchgrass.

Sphagnum bogs were formerly numerous and well-developed

Fig. 2. Serpentine-limonite barrens, Fox Hills. Little bluestem disclimax. *Hesperia metea, Atrytonopsis hianna, Atrytone arogos.*

Fig. 3. Acid-sand barrens, Woodrow. Blueberry, catbrier, blackjack, and scrub oaks. Oak-feeding *Erynnis* and *Satyrium.*

Fig. 4. Sphagnum bog, Bloomfield. Habitat of *Euphyes dion, E. bimacula, E. conspicua, Lethe eurydice, Poanes viator, P. massasoit.*

Fig. 5. Tussock sedge in boggy stream, Bloomfield, *Lethe appalachia, Poanes massasoit, Euphydryas phaeton.*

in the sandy areas, but are now restricted to a few sites in Chelsea, Woodrow, and Bloomfield and have lost many of their distinctive plants. Aside from the peat mosses, characteristic species today include various sedges (*Carex, Cyperus,* several species), bur-reed (*Sparganium eurycarpum*), buttonbush (*Cephalanthus occidentalis*), poison sumac (*Rhus vernix*), and bunchtop bluestem (Fig. 4). The bogs are usually ringed by a red maple (*Acer rubrum*) zone forming a transition to the lowland oak forest (Fig. 5, 7).

The Tottenville area includes sand scrub, much of it burned in a particularly hot wildfire in 1962 and now supporting very dense populations of sassafras (*Sassafras albidum*) seedlings. One pine barrens-blackjack oak area still exists along Hylan Blvd. The southernmost tip of the Island, at Ward's Point, has a richer soil supporting thickets of hackberry (*Celtis occidentalis*), as well as some local herbs, including yellow giant hyssop (*Agastache nepetoides*) and feverwort (*Triosteum perfoliatum*).

The unglaciated coastal plain along the south shore is all highly disturbed and is mostly covered by an array of sandy-(circumneutral)-soil weeds such as white sweetclover (*Melilotus alba*), goat's beard (*Tragopogon pratensis*), camphorweed (*Heterotheca subaxillaris*), seaside goldenrod (*Solidago sempervirens*) and other goldenrods, narrow-leaved thoroughwort (*Eupatorium hyssopifolium*), and many beach grasses (e.g., triple awn, *Aristida tuberculosa*). The salt marshes behind the beaches have been filled and are dominated by tall reed (*Phragmites communis*); near the bungalows are thickets of cottonwood (*Populus deltoides*), black cherry, willow, and winged sumac.

The Fresh Kills salt marshes on the west shore support the usual coastal vegetation, with cordgrass (*Spartina* spp.) covering large areas; behind the cordgrass are meadows of marsh spikegrass (*Distichlis spicata*) with associated herbs (orach, *Atriplex hastata;* water hemp, *Acnida cannabina;* salt-marsh fleabane, *Pluchea purpurascens*) and subshrubs (*Iva axillaris* and *Baccharis halimifolia*) (Fig. 8). More than half the salt marsh area has been obliterated by sanitary landfill, which unlike the hydraulic landfill on the south shore has a large flora of annual weeds. Some of these, which may form large stands, are rare or absent elsewhere on the Island (e.g., *Kochia scoparia,* Chenopodiaceae).

The long-urbanized north shore has many vacant lots occu-

Fig. 6. Scrub and young oak-black gum forest on wet acid sand, Mariner's Harbor. *Hesperia metea, Satyrium liparops, Erynnis icelus.*

Fig. 7. Buttonbush-sedge bog, Woodrow. *Euphydryas phaeton, Poanes massasoit, Satyrium falacer* and *caryaevorus.*

Fig. 8. Salt meadows, Bloomfield. Pin oak forest in background. Habitat of *Panoquina panoquin* and *Poanes viator.*

pied by adventive weeds such as annual and perennial wormwoods (*Artemisia annua, A. vulgaris*), peppergrass (*Lepidium virginicum*), common and giant ragweeds (*Ambrosia artemisiifolia* and *A. trifida*), horseweed (*Leptalon canadense*), dumpheap sunflower and Jerusalem artichoke (*Helianthus annuus* and *tuberosus*), white sweetclover, Mexican tea and lamb's quarters (*Chenopodium ambrosioides* and *C. album*), giant and green foxtails (*Setaria faberii* and *S. viridis*), etc. The succession on vacant lots results in glades of tree-of-heaven (*Ailanthus altissima*) with an understory of Japanese honeysuckle (*Lonicera japonica*) and Japanese knotweed (*Polygonum cuspidatum*). In some locations, especially on serpentine, red and paper mulberries (*Morus rubra, Broussonetia papyrifera*) and smooth aster(*A. laevis*) may be prominent.

Permanently disturbed commercial waterfront areas in Stapleton, Saint George, and Port Ivory-Howland Hook have a diverse weedy vegetation including ballast relicts not found elsewhere on the Island. Examples are Jerusalem oak (*Chenopodium botrys*), catnip (*Nepeta cataria*), and nodding thistle *Carduus nutans*).

The Butterfly Fauna

Except for the marked acid soil-Pine Barrens element, Staten Island's butterfly fauna closely resembles that of the Tinicum-Eastwick area in southwest Philadelphia (Shapiro, 1970a). There are 73 species recorded from Tinicum and 106 from Richmond County (92 recently); the two lists have 69 species in common. The list of shared species includes all of the widespread, common colonizing species and most of the migrants. Although the potential climax vegetation of the two areas is similar, Tinicum is more recently and uniformly disturbed. The vegetation of non-marsh habitats at Tinicum is similar to that of similarly de-developed areas on Staten Island, and this accounts for the very close faunal similarities. The four species found at Tinicum but not on Staten Island are *Urbanus proteus, Thorybes confusis,* and *Erynnis zarucco*—all at the northern extremities of their ranges at Philadelphia; and *Asterocampa clyton* which is replaced on Staten Island by *A. celtis* (not found at Tinicum, although the two species are extensively sympatric and at least in the south often occur together).

The species found on Staten Island but not at Tinicum are a heterogeneous lot. Northern species not penetrating the coastal plain south to Tinicum are *Nymphalis j-album, N. milberti,*

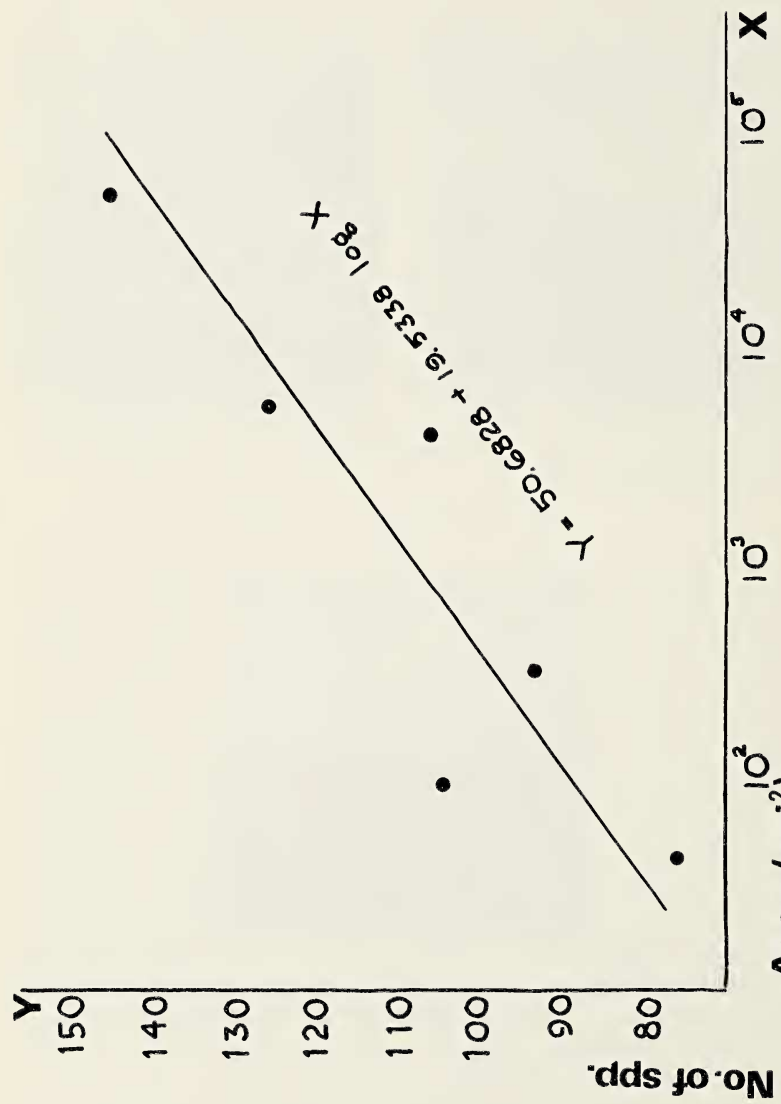

Fig. 9. Regression of species number on log area for well-studied northeastern U.S. butterfly faunas.

Lethe anthedon, Speyeria aphrodite, Boloria toddii, Polygonia progne, Satyrium acadica, Erynnis martialis, Polites mystic, and *Pieris "napi"* (probably *P. virginiensis*). All of these except the last have been taken on the upland piedmont within 35 miles of Philadelphia—most of them actually within the city limits.

The Staten Island fauna has been compared in detail with those of five other areas in the northeast which have been intensively collected by single individuals using uniform methods over the entire season. The relationship of area to species number was determined for these six areas by means of regression; species number is a linear function of log area (Figure 9). The data used are given in Table 1.

The predicted species number for Staten Island based on area alone is 86.73. The observed value of 104 (106) actually exceeds the estimate plus the standard error of estimate and is the largest percentage deviation from predicted values of the six localities. This very high number probably reflects the Island's seaboard location; of the 104 species considered, at least 14 can be considered irregular immigrants from the south, and at this latitude these are confined to the immediate coastal strip. Some of the overall unexplained variance is probably due to latitude alone; this applies in particular to the low figure for central New York. The low numbers for Tinicum and the District of Columbia both probably reflect the loss of special habitats and their associated species.

The composition by family of the faunas (Table 2) also sheds light on their differences. The families with wide-ranging, ecologically tolerant species (Papilionidae, Pieridae, part of Nymphalidae) show little increase in species number with area. The two families with many highly specialized species—Lycaenidae and Hesperiidae—show a steady increase in species number with area. (The Virginia value for Lycaenidae is certainly an underestimate, possibly by 5-10 species.) The most striking difference between the Tinicum and Staten Island lists is the lack of Lycaenidae in the former.

Most of the missing Lycaenid species are associated with acid-soil vegetation, as are some of the missing Hesperiids: *Satyrium edwardsii, S. liparops, Incisalia irus, I. augustinus, I. niphon, Erynnis icelus, E. brizo, E. baptisiae, Hesperia leonardus.* Species associated with serpentine vegetation, which does not occur at Tinicum, include *Hesperia sassacus, Atrytonopsis hianna, Atrytone arogos,* and perhaps *Hesperia attalus.* The lack of sphagnum bogs and sedgy areas at Tinicum—these pre-

Table 1. Data for regression analysis of species-area relationship in northeastern U.S. butterfly faunas.

Locality	No. of Spp. Y	Area (sq.mi.)	Log Area X	Reference	Calculated No. of Spp. Y_x
Tinicum-Eastwick[a]	73	40	1.6021	Shapiro, 1970	82
Staten Island	104[b]	70	1.8451	Present paper	87
District of Columbia	92[c]	250[d]	2.3979	Clark, 1932	98
Central New York[e]	105[f]	3669	3.5646	Shapiro, unpublished	120
Delaware Valley, Pa. - N.J.	128	3846	3.5850	Shapiro, 1966	121
Virginia	146[g]	40815	4.6108	Clark and Clark, 1951	141

Regression of Y on X: $Y_x = 50.6828 + 19.5338\ X$

Standard error or estimate: 13.4604

Percentage of variance accounted for by regression: 78.37%

Notes: [a]Philadelphia and Delaware Counties, Pennsylvania

[b]*Pieris* undetermined species and *Papilio palamedes* excluded.

[c]Underestimate, probably by at least 5 species.

[d]Approximation from the rough boundaries indicated by Clark, 1932.

[e]Tompkins, Schuyler, Cortland, Tioga, Chemung and Steuben Counties.

[f]*Phoebis philea* excluded

[g]Underestimate, probably by 10 species

viously occurred but were drained and/or filled before 1920—excludes the three sedge-feeding *Euphyes* and *Poanes massasoit*, all of which still occur near Philadelphia. Seemingly suitable habitats exist at Tinicum for *Harkenclenus titus*, *Satyrium caryaevorus*, and *Feniseca tarquinius*, and any of these could still turn up there. The European Skipper, *Thymelicus lineola*, colonized Staten Island about 1968-69 (Shapiro, 1971) and is also likely to have entered Tinicum since the survey of that area was completed in 1966; it has been reported from Bucks, Montgomery, Delaware, and Chester Counties, Pennsylvania. *Mitoura gryneus*—like its host plant, red cedar—is found at neither locality today. Finally, there are three southern strays reported from Staten Island but not from Tinicum. Two of these, *Panthiades m-album* and *Graphium marcellus*, occur frequently around Philadelphia. The third, *Papilio palamedes*, was taken so far out of range that it must be considered an extremely rare instance of long-distance dispersal.

Like Tinicum, Staten Island is on the Atlantic migratory flyway and receives substantial numbers of immigrant butterflies from the south. Being farther north than Tinicum, it receives them more sporadically; breeding, when it occurs, begins later in the season and overwintering is less frequent. Winter survival of southern species requires not only shelter from cold, desiccating winds but proper timing of the life cycle so that the most resistant stages are available to survive the winter. This is an exceptional circumstance in a climate as irregular at that of Staten Island. Being directly on the coast, the Island is a feeding and assembly area for great numbers of monarchs and, at times, of painted ladies and other mass migrants (Shapiro, 1970b). There is reason to believe that migrant monarchs from southern Ontario, upstate New York, and all of New England converge on Staten Island. The great amounts of flowering goldenrod and aster on the south shore are an important food source for the migratory swarms. Their welfare may be jeopardized if the coastal strip is developed and this food source is no longer available.

On the whole, Staten Island has fared extraordinarily well to date insofar as retention of its butterfly fauna is concerned. Only two resident species—*Incisalia niphon* and *Mitoura gryneus*—have definitely disappeared in the past century, both with the eradication of their host plants. A third, some sort of *Pieris*, was probably gone well before then. *Incisalia augustinus*, *Hesperia sassacus*, *Erynnis brizo* and *Thorybes bathyllus* are not

known definitely from the Island at this time but any or all may still be present. The other missing species—*Nymphalis j-album, N. milberti, P. s. eubule, C. caesonia, G. marcellus, P. cresphontes, P. communis*—are all probably immigrants, some of which have bred at times in the past and may do so again. Staten Island has gained two resident species—*Colias eurytheme* and *Thymelicus lineola*—and populations of another, *Poanes viator,* have increased greatly due to man's activities.

Despite changes in the extent and character of forests and serpentine barrens on the Island, the butterflies of these habitats have not suffered appreciably because the plant species on which they depend have not suffered. Staten Island forests probably never were very rich in butterflies; the persistence of such species as *Lethe anthedon* and *L. appalachia* is mildly surprising.

Many of the species which Davis regarded as widespread, common Island residents have undergone great reductions of population size and restriction of ranges. A number of these are obviously endangered; known today from only one or two localities, they could be eliminated from the Island by a few hours' work with a bulldozer. Most or all of them, moreover, will be. They are located on the west shore in the acid barrens area recently zoned as an industrial park, or in the oak scrub scheduled to become the "new city" of South Richmond in Huguenot and Pleasant Plains. Even if the Staten Island "green belt" can be protected against its numerous enemies, it contains upland oak forests and serpentine barrens but no acid scrub suitable for these species. Butterflies likely to become extinct on Staten Island within five years are *Lethe appalachia, L. eurydice, Speyeria idalia, S. aphrodite, Boloria selene, B. toddii, Euphydryas phaeton, Chlosyne nycteis, Polygonia progne, Satyrium acadica, S. liparops, S. edwardsii, Incisalia irus, Hesperia leonardus, Polites mystic, Poanes massasoit, Atrytone arogos, A. logan, Euphyes dion, E. conspicua,* and *E. bimacula,* a total of 21 species, or one-fifth of the recorded fauna.

Several normally common butterfly species—*Cercyonis alope, Speyeria cybele, Limenitis astyanax, L. archippus, Polygonia comma, Euphyes ruricola*—were at alarmingly low levels in 1971. Their scarcity could be due to intrinsic cyclicity, aerial spraying for mosquitoes, air pollution, or a multitude of other factors. As widespread, successful species in the northeast, however, they presumably have high enough rates of dispersal and increase to rebound from their present lows when conditions

are once again suitable for them. The specialized, acid-barrens and bog species have nothing in their favor but delays in bulldozing. For them, densities are approaching irreversible lows, or the extent of suitable habitat is nearing the point of no return.

The future of the Island fauna can be seen in the vacant lots on the decaying north shore. The butterflies of vacant lots in Saint George or Stapleton are the same as those in Queens, Newark, or Philadelphia: *Phyciodes tharos, Strymon melinus, Everes comyntas, Pieris rapae, P. protodice, Colias eurytheme,* and *Pholisora catullus.* (The checkered skipper, *Pyrgus communis,* joins the association from Philadelphia southward.) All of these species are vagile colonizers with high reproductive rates, feeding on weeds and obviously tolerant of air pollution. They and *Poanes viator,* which swarms on undeveloped hydrofills, have increased in numbers and range as the native and specialized forms have declined. Some of the common upland and serpentine species will persist in the green belt, just as they have in the Terminal Moraine Natural Area System in Queens; so *Satyrium falacer, S. caryaevorus, Nymphalis antiopa, Euptychia cymela, Speyeria cybele, Poanes zabulon, P. hobomok,* and *Erynnis juvenalis* will remain in the Island fauna. So will the strongly migratory *Precis coenia, Danaus plexippus,* and three *Vanessa* spp. This leaves us a fauna of some 21 species to look forward to by the year 2000, a fauna virtually identical to that of the borough of Queens today. If there are more discoveries to be made in the Staten Island butterfly fauna, they had better be made soon.

Annotated List of Species

SATYRIDAE

1. *Lethe anthedon* A. H. Clark. Northern Pearly-Eye

Apparently rare. Two single records in the serpentine highlands in densely wooded country. Univoltine everywhere in the north. Population levels of this species tend to fluctuate both locally and from season to season; it may be found commonly some years in places where it is usually rare, and this may be true on Staten Island.

HOST PLANTS: Not recorded on Staten Island. Presumably a grass, perhaps a *Muhlenbergia*? (*Brachyelytrum* and *Uniola*, both recorded hosts, do not occur here.)

RECORDS: Brielle Ave. near Buck's Hollow, vii.21.71; Rockland Ave. near Sea View Hospital, vii.16.71.

2. *Lethe appalachia* R. L. Chermock. Southern Eyed Brown

Local but frequent in sedgy areas near streams through brushy country, on Staten Island mainly on the acid lowlands. The butterflies remain in shady situations, not visiting flowers; apparently associated with tussock sedge (*Carex stricta*) in Bloomfield. One brood, July.

HOST PLANTS: *Carex stricta*? Perhaps other *Carex*.

RECORDS: Willowbrook, vii.21.71; South Avenue, Bloomfield, vii.22.71, vii.27.71.

3. *Lethe eurydice* Johansson. Northern Eyed Brown

Sedgy marshes and acid bogs with abundant sunshine, very local but frequent where it occurs. Unlike the southern eyed brown, this species visits blossoms of swamp milkweed (*Asclepias incarnata*) and Joe-Pye weed (*Eupatorium* spp.) rather freely. One brood, mainly in July ("June to September," Davis). Represented in the U.S. National Museum by two Island specimens with incomplete data. Not seen in the same localities as *L. appalachia* on the Island.

HOST PLANTS: Not recorded here; probably *Carex*, perhaps *C. stricta*.

RECORDS: Mariner's Harbor (Arlington), vii.15.71, vii.31.71; South Avenue bogs, vii.22.71, vii.27.71, viii.16.71; Midland Beach, viii.15.71. Recorded by Richard Pine from near Susan Wagner High School, Sea View, vii.20.71.

4. *Euptychia cymela* Cramer. Little Wood Satyr

Common and widespread throughout in brushy meadows and open woods, regardless of soils; common in mulberry thickets on serpentine, Stapleton. One brood, June to late July ("last days of May . . . to first days of August," Davis). This species frequents hedgerows and dense vegetation, and is difficult to capture unless it can be kept in the open.

HOST PLANTS: Orchard grass (*Dactylis glomerata*) (ova, Stapleton).

RECORDS: Stapleton, vii.1.71; Mariner's Harbor, vii.1.71; South Avenue, Bloomfield and Chelsea, vii.2.71, vii.12.71, vii.27.71; Pleasant Plains, vii.3.71; Tottenville, vii.3.71, vii.14.71; Todt Hill, vii.4.71; Buck's Hollow, vii.4.71; Travis, vii.6.71; Sea View, vii.16.71; Midland Beach, vii.20.71; Willowbrook, vii.21.71. (vii.1-vii.27)

5. *Cercyonis alope* Fabricius. Common Wood Nymph

Frequent and widespread in brush land, including the acid west shore. Common in hedgerows on the grounds of Willowbrook State School, straying into adjacent meadows. Absent from extensive bluestem (serpentine) areas. "June to September inclusive" (Davis). July-mid August, 1971; one brood. Not very variable on Staten Island, our population perhaps best

called *maritima* Edwards (FW blotch deep rusty orange, slightly clouded with brown in some specimens). When alarmed, the butterflies dodge into cover. A pair taken *in copula* at Willowbrook, vii.21.71, 11.50 a.m.

HOST PLANTS: Grease grass, purple top (*Tridens flavus*) (ova, larvae, Willowbrook); perhaps other grasses.

RECORDS: South Avenue, Mariner's Harbor, vii.2.71; South Avenue, Bloomfield, vii.12.71, vii.27.71, vii.16.71; Tottenville, vii.14.71, vii.28.71; Willowbrook, vii.21.71; Wolfe's Pond Park, vii.2.71. (vii.2-viii.16).

DANAIDAE

6. *Danaus plexippus* Linnaeus. Monarch (Fig. 11c)

Abundant everywhere in open country after midsummer, continuously brooded, probably two to four broods, depending on the timing of the spring immigrants. "May to November inclusive," Davis, includes a record of xi.25.94. Staten Island is on the main migratory flyway. Davis records migrations on ix.29.89 and ix.8.99 (the latter seems very early). On x.7.70 some 50,000 were seen on the beach at Great Kills Park. The 1971 peak came on ix.24, with 20-25,000. On the 1970 date a specimen tagged at Cobourg, Ontario was collected (locality confirmed by Dr. F. Urquhart, University of Toronto).

Migrants accumulate on the south shore during spells of settled, warm, dry weather, feeding on the abundant asters and goldenrods. Predation by the Chinese mantis (*Paratenodera sinensis*) is heavy at this time. The huge flocks depart ahead of stormy weather, apparently with the onset of a sustained strong wind, but stragglers continue to appear for weeks and secondary buildups may occur. Although monarchs are normally sexually inactive while migrating, a pair *in copula* was observed at South Beach on x.28.71 at 3 pm. with the temperature in the mid 60's.

Many abnormal monarchs have turned up in the migratory swarms. Some fifteen with depigmentized blotches on the wings (similar to those produced by microcauterization of the pupal prismatic maculae, Urquhart and Tang 1971) have been taken. On September 6, 1970 in the early part of the migration, a female with all the subapical spots white was taken at Willowbrook. This individual (Fig. 10f) closely resembles the tropical American subspecies *megalippe* Hubner. There is at least one prior record of this "form" in New York (Clark and Clark, 1951).

HOST PLANTS: Milkweeds: *Asclepias syriaca* (ova, larvae, Mariner's Harbor, Saint George, Tottenville), *A. incarnata* (Woodrow, Tottenville). Probably other *Asclepias*.

RECORDS: Fox Hills, vii.31.70, ix.11.70, ix.16.71, x.12.71; Willowbrook, ix.6.70, x.16.71; Richmondtown, ix.13.70, x.13.71; New Springville, ix.20.70; Great Kills, ix.26.70, x.7.70, ix.24.71; Tottenville, x.5.70, vii.18.71, ix.22.71, x.6.71; Port Richmond, x.20.70, x.23.70, xi.1.70, xi.3,70, xi.9.70, ix.3.71, xi.2.71; Wolfe's Pond Park, x.24.70; Graniteville, x.28.70; Old Place, xi.7.70; Mariner's Harbor, vii.1.71, viii.14.71, x.27.71; South Avenue, Bloomfield, vii.2.71, ix.1.71; Port Ivory, vii.15.71; Sea View, vii.16.71, x.30.71; Midland Beach, vii.20.71, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71, x.29.71, xi.4.71, xi.6.71; Annadale, ix.25.71; Travis, ix.29.71; Oakwood, x.5.71, x.28.71, xi.18.71; New Dorp, x.21.71. (vii.1-xi.18)

HELICONIIDAE

7. *Agraulis vanillae* Linnaeus. Gulf Fritillary

A rare migrant from much further south, recorded once. The normal food plants, *Passiflora* spp., do not occur here.

RECORDS: Port Richmond, xi.1.70.

NYMPHALIDAE

8. *Euptoieta claudia* Cramer. Variegated Fritillary

A scarce but perhaps consistent immigrant. "Less than a dozen specimens have been seen and these usually in late summer and fall. The earliest record is July 11, at Richmond Valley. Two specimens observed . . . at Dongan Hills on September 18, 1910" (Davis). Weedy roadsides and dry fields, visiting flowers freely. The males are very strong fliers and appear to "fly a beat." Not known to breed on Staten Island, but food plants (*Viola*) are available. Multiple brooded in the south, breeding and overwintering some years as far north as Philadelphia.

RECORDS: Great Kills, ix.23.70; Graniteville, x.28.70; Fox Hills, ix.16.71; Travis, ix.29.71; Midland Beach, xi.6.71.

9. *Speyeria idalia* Drury. Regal Fritillary

Apparently rare today; a species noted for its fluctuations in abundance. "Last days of June through July, August and September" (Davis). Generally a resident of wet meadows, especially upland, with violets and abundant wildflowers; the single Staten Island capture was made on a roadside Black-eyed Susan (*Rudbeckia hirta*) in brush land near Clermont Avenue and Aspinwall Street.

RECORDS: Tottenville, vii.5.71.

10. *Speyeria cybele* Fabricius. Great Spangled Fritillary

Formerly common ("June, July, August, and September. The males appear in numbers in June a day or so before the females," Davis) but now unaccountably rare, perhaps at an abnormal (and transient) low level in 1971. Open country generally, visiting milkweed blossoms. One brood a year.

HOST PLANTS: Presumably violets, as elsewhere.

RECORDS: South Avenue, Chelsea, vii.12.71, viii.16.71; Tottenville, vii.14.71; Sea View, vii.16.71.

11. *Speyeria aphrodite* Fabricius. Aphrodite Fritillary

Local, but frequent, on acid-soil areas on the west shore and at Tottenville; not seen elsewhere. Most often noted on milkweeds by the roadside in scrubby country. Numbers of this species may have increased since Davis' time, since he wrote: "A single specimen taken on June 29. One seen at close range in the Clove Valley . . . August 2, 1908." In upstate New York generally found upslope of *S. cybele* and on poorer soils, but not extending on the acid sand into the New Jersey pine barrens. Staten Island may represent its southernmost record on the Atlantic coastal plain.

HOST PLANTS: Oviposits on and near *Viola lanceolata, V. primulifolia,* and *V. fimbriatula* (west shore).

RECORDS: Univoltine. Tottenville, vii.14.71; South Avenue, Mariner's Harbor to Travis, vii.22.71, vii.27.71, viii.16.71.

12. *Boloria selene myrina* Cramer. Silver-bordered fritillary

"May to September inclusive" (Davis). Very local, two colonies known but frequent at each; two or three broods. Suitable habitats for this species —wet, sedgy meadows—have decreased in extent since Davis' time. At Midland Beach it occurs along the edge of a reed marsh and strays into adjacent brush.

HOST PLANTS: Unknown, but perhaps not violets on the Island; a suspected willow feeder in parts of upstate New York.

RECORDS: Tottenville, vii.5.71, ix.22.71; Midland Beach, vii.20.71.

13. *Boloria toddii* Holland. Meadow Fritillary

Apparently greatly decreased in numbers since Davis' time, but the Meadow Fritillary is well-known for its eruptive tendencies and may again become common in suitable habitats, grassy wet meadows. "June, July and August . . . formerly found in the Clove Valley . . . a single specimen in Buck's Hollow, August 7, 1910."

HOST PLANTS: Probably violets, as elsewhere.

RECORDS: Tottenville, vii.14.71, x.6.71; Pleasant Plains, v.10.71, vii.3.71; three broods?

14. *Euphydryas phaeton* Drury. Baltimore

Rare and local today, by boggy ditches and swales on the west shore. One brood (July, 1971: "May and June, sometimes in considerable numbers" (Davis); often in June on the New Jersey Piedmont). A colony of wintering larvae observed on the food plant on Woodrow Road near Winant Avenue, Woodrow, September 25, 1971.

HOST PLANT: Turtlehead (*Chelone glabra*), still a fairly frequent marsh and bog plant on the Island.

RECORDS: South Avenue, Bloomfield, vii.12.71, vii.22.71.

15. *Chlosyne nycteis* Doubleday. Silver Crescent

Rare, in acid scrub. Unreported for the Island by Davis. Probably at least partially double-brooded as it is in Westchester County. The largest female I have ever seen was taken July 3, 1971 on a brush trail in Huguenot.

HOST PLANTS: Perhaps *Helianthus* species.

RECORDS: Huguenot, vii.3.71; Tottenville, ix.6.71.

16. *Phyciodes tharos* Drury. Pearl Crescent

Abundant everywhere in open country, including vacant lots. Continuously brooded, three to four broods, the larvae overwintering. Late April-mid November ("early May to October inclusive," Davis). Comstock (1940) records this species from "Staten Island, March 29." The record (Davis, 1910) is actually of a larva found iii.29.03.

Spring and autumn specimens, especially females, are heavily marked beneath (form *marcia*): a few April and May specimens extremely so.

HOST PLANTS: *Aster pilosus, ericoides,* and *laevis* (numerous stations; ova and larvae).

RECORDS: Fox Hills, vii.31.70, ix.11.70, v.24.71, ix.16.71, x.12.71; Willowbrook, ix.6.70, vii.21.71, x.16.71; Port Richmond, x.20.70, ix.4.71, ix.12.71; Graniteville, x.28.70; Mariner's Harbor, iv.21.71, x.1.71, x.27.71; Pleasant Plains, v.10.71, vii.3.71; South Avenue, Arlington to Travis, v.12.71, v.27.71, vii.2.71, vii.12.71; Todt Hill, v.18.71; Tottenville, v.25.71, vii.14.71, ix.6.71, ix.22.71, x.6.71; Huguenot, v.26.71; Stapleton, vii.1.71, ix.7.71; Sea View, vii.16.71, x.30.71; Midland Beach, vii.20.71, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71, x.29.71, xi.6.71, xi.17,71; Annadale, ix.25.71; Travis, ix.29.71; Oakwood, x.5.71, x.28.71; South Beach, x.8.71; New Dorp, x.21.71. (iv.21-xi.17)

17. *Polygonia interrogationis* Fabricius. Question Mark

Common in mid- to late summer in highly disturbed, overgrown habitats, especially on the north and south shores. Not seen in spring and only twice in fall, these being the only records of the winter (light) form; perhaps, as in central New York, not always overwintering here. Several males of the summer (dark) form took up territorial positions on a stone wall at Swan and Homer Streets, Stapleton, about 90 minutes before sunset daily in late July. Eight larvae collected on the Island were all parasitized by a Tachinid, *Compsilura concinnata.*

On July 21, 1971 this species, *P. comma,* and *Vanessa atalanta,* were all common at flowing sap on an injured red maple near the Victory Blvd. entrance to Willowbrook Park, showing no inter- or intraspecific aggression while feeding.

HOST PLANTS: Japanese Hop (*Humulus japonicus*) (larvae, Stapleton, Port Richmond, Midland Beach).

RECORDS: Summer forms: Fox Hills, vii.31.70; Tottenville, vii.14.71; Midland Beach, vii.20.71; Willowbrook, vii.21.71; South Avenue, Bloomfield, vii.22.71; Stapleton, vii.22.71; Mariner's Harbor, vii.31.71. Winter forms: New Springville, ix.20.70; Stapleton, x.14.71. (vii.14-ix.20).

18. *Polygonia comma* Harris. Comma

Infrequent, in habitats similar to the last. Probably both widespread *Polygonias* have two generations yearly, but the data are scanty. "Less common than (the Question Mark)" (Davis).

HOST PLANTS: Unknown locally; presumably Ulmaceae or Urticaceae.

RECORDS: Buck's Hollow, x.1.70 (winter form); South Avenue, Chelsea, vii.2.71; Willowbrook, vii.21.71 (summer forms).

19. *Polygonia progne* Cramer. Gray Comma

Davis records a single specimen at Richmondtown, February 24, 1906. One modern record at Tottenville, a male sitting in the middle of Clermont Avenue. In upstate New York, an upland species of woods edges and brushy situations.

HOST PLANTS: Unknown on Staten Island.

RECORD: Tottenville, x.6.71.

20. *Nymphalis j-album* Boisduval and LeConte. Compton Tortoise

No modern records. "Hibernated individuals in early spring and fresh examples in midsummer. About one-half of the specimens taken on the Island have been found in dwellings, usually in the fall" (Davis). A northern species with notoriously unstable populations; occasional in the Pine Barrens and south to Philadelphia. Perhaps extinct in the entire New York metropolitan area.

21. *Nymphalis antiopa* Linnaeus. Mourning Cloak

"Sometimes seen as early as the latter part of February and as late as November." April-November, frequent, mostly in sunlit spots in woodlands (at all elevations), and occasional on milkweeds and other tall roadside flowers. One taken indoors in an apartment building November 6, 1970 circling a light bulb at 11:30 p.m. Probably one brood, perhaps with a partial second some years.

HOST PLANTS: Willows (*Salix nigra*) (larvae, Willowbrook); Cottonwood (*Populus deltoides*) (larvae, Midland Beach); preferring small or shrubby specimens.

RECORDS: Port Richmond, xi.6.70; South Avenue, Bloomfield and Mariner's Harbor, iv.11.71, vii.2.71, vii.12.71; Todt Hill, vii.4.71; Buck's Hollow, vii.4.71; Willowbrook, vii.21.71.

22. *Nymphalis milberti* Godart. Milbert's Tortoise Shell

Presumably extinct on Staten Island. "One specimen taken near Silver Lake . . . in October 1886. Seen at Clifton . . . October 13, 1902 and on September 25, 1910" (Davis). A northern species of disturbed, weedy sites near dwellings and on flood plains, ranging occasionally south to Philadelphia. Triple-brooded in central New York. The host plants, stinging nettles, are common on Staten Island.

23. *Vanessa atalanta* Linnaeus. Red Admiral

Frequent and widespread in open country, particularly in disturbed, weedy sites, and on stream banks near the host plant. Recorded by Davis, "March to November inclusive. One seen December 13, 1891." Partially double-brooded, the main flight in midsummer. The males are territorial in late afternoon and remain active into twilight. "Wet form" individuals are larger and blacker than "dry form" ones, often with the red band interrupted; the "wet form" commonest in midsummer.

HOST PLANTS: Nettle (*Urtica dioica*) (larvae abundant, Travis); Pellitory (*Parietaria pensylvanica*) (larvae, Mariner's Harbor).

RECORDS: Fox Hills, ix.11.70; Richmondtown, ix.13.70; New Springville, ix.20.70; Great Kills, x.7.70, ix.24.71; Mariner's Harbor, vii.1.71, vii.15.71; South Avenue, Chelsea, vii.2.71; South Avenue, Bloomfield, vii.12.71; Todt Hill, vii.4.71; Port Ivory, vii.15.71; Willowbrook, vii.21.71; Port Richmond, viii.17.71, ix.3.71; Travis, ix.29.71; Oakwood, x.28.71. Hibernators not observed in 1971. (vii.1-x.28)

24. *Vanessa cardui* Linnaeus. Painted Lady

"August, September, and October, but not common. Plentiful in September 1884. A single example near Richmond(town), April 24, 1897" (Davis). The occurrence of this species on Staten Island depends on the strength of its migration, as it does not normally overwinter in the northeast. Abundant in September-October 1970, especially on and near the south shore, and apparently migrating southward with the monarchs on October 7. Only one individual seen in 1971. Continuously brooded in good years, up to three generations when breeding begins in May or early June.

HOST PLANTS: Larval nests common on thistles (*Cirsium vulgare, C. discolor*) (Tottenville, Mariner's Harbor, Travis, Fox Hills) in 1970.

RECORDS: Fox Hills, ix.11.70; New Springville, ix.20.70; Great Kills, ix.26.70, x.7.70; Port Richmond, x.19.70; Wolfe's Pond Park, x.24.70; Tottenville, x.6.71.

25. *Vanessa virginiensis* Drury. Painted Beauty, American Painted Lady

Frequent generally in open country, including gardens and vacant lots, but common only on the south shore beaches with its food plant. At least two broods ("early spring to November inclusive," Davis). Observed migrating with *V. cardui, D. plexippus,* and a few *V. atalanta* at Great Kills, x.7.70.

On ix.11.70 some ten males of this species were "defending" territories on hilltops in Fox Hills about 45 minutes before sunset.

HOST PLANTS: Sweet Everlasting (*Gnaphalium obtusifolium*); larvae common at Great Kills and South Beach.

RECORDS: Fox Hills, vii.31.70, ix.11.70; Great Kills, ix.23.70, ix.26.70, x.7.70, ix.24.71; Port Richmond, x.24.70, xi.1.70, xi.8.70, i.9.70; Tottenville, v.25.71, vii.14.71, x.6.71; Port Ivory, vii.15.71; Willowbrook, vii.21.71; South Avenue, Chelsea, vii.22.71; Travis, ix.29.71; Oakwood, x.5.71; South Beach, x.8.71; Midland Beach, x.26.71, x.29.71, xi.17.71. (v.25-xi.17)

26. *Precis coenia* Hubner. Buckeye (Figs. 10a-c)

Common and general in low, open country especially on the beaches; less frequent on the north shore, and seemingly absent from the high hills. "June to November inclusive," continuously brooded and continuing to emerge until hard frost. The Buckeye probably does not overwinter at all

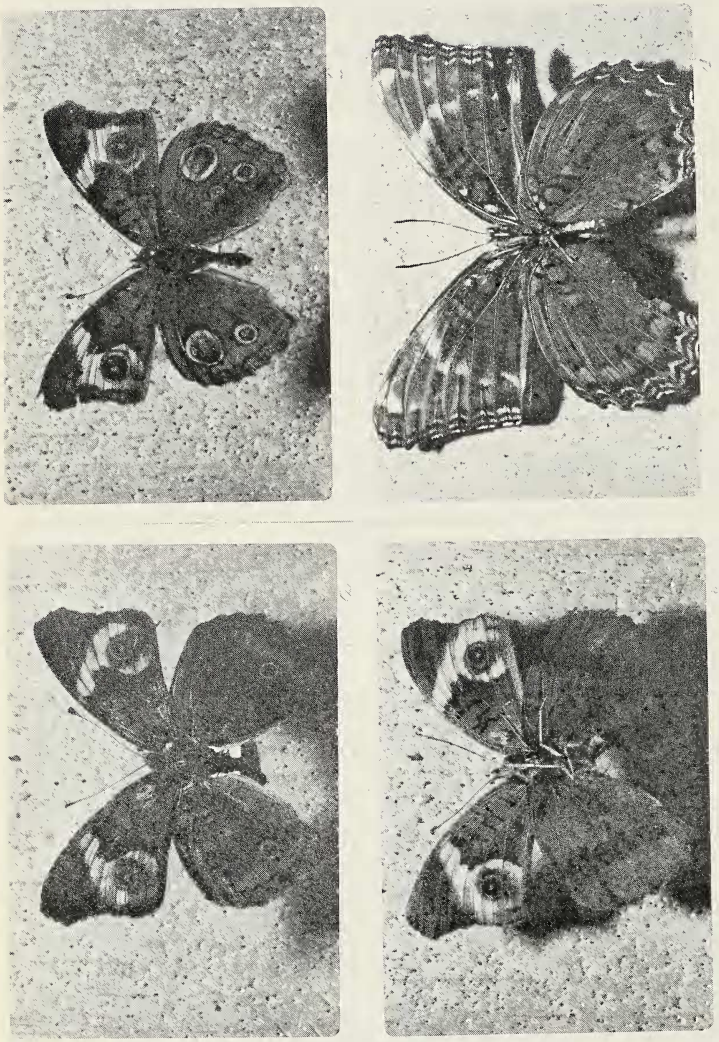

Fig. 10. a. *Precis coenia* melanic, dorsum. Midland Beach, x.26.71.
b. same specimen, ventral surface.
c. *P. coenia* with supernumerary ocellus, Midland Beach, x.18.71.
d. *Limenitis astyanax "proserpina"* ♀. Tottenville, vii.14.71.

on Staten Island, and is dependent on recolonization from further south in early summer.

The "wet" form, with the hindwing infuscated with purplish-red ventrally, was common on the south and west shores in the 1971 season; some extreme specimens were taken, including a melanic with heavy black scaling covering the entire fore ocellus of the hindwing dorsally. An extremely variable species, producing many minor aberrations. A specimen with an asymmetrical supernumerary hindwing ocellus was taken x.18.71.

HOST PLANTS. Larvae common on ribbed or English plantain (*Plantago lanceolata*) (South Beach).

RECORDS: New Springville, ix.20.70; Great Kills, ix.23.70, ix.26.70, x.7.70, ix.24.71; Wolfe's Pond Park, x.24.70; Port Richmond, xi.1.70, xi.2.71; South Avenue, Travis, vii.12.71; Tottenville, vii.14.71, ix.6.71, x.6.71; Midland Beach, vii.15.71, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71 (melanic), x.29.71, xi.6.71; Fox Hills, ix.16.71, x.12.71; Annadale, ix.25.71; Travis, ix.29.71; Oakwood, x.5.71, x.28.71 (2 abnormal); Saint George, x.14.71; New Dorp, x.21.71. (vii.12-xi.6)

27. *Limenitis astyanax* Fabricius. (*L. arthemis astyanax*) Red-Spotted Purple (Fig. 10d)

Infrequent, local, in disturbed thickets and hedgerows, but not seen on acid or serpentine soils. Davis apparently found this species much commoner than it is today: "occasional in May, a few in June, common in late July and throughout August, and a few in September." He also records a female of form *albofasciata*, Woodrow, vii.25.07. A female of form *proserpina*, with traces of the white band beneath, was taken at Tottenville, vii.14.71.

At Midland Beach this species was fairly numerous among the cottonwoods behind the bungalows. The males are territorial from mid-day through mid-afternoon, perching on projecting twigs 10-15 feet above the ground.

HOST PLANTS: Associated with cottonwood and black cherry, both of which are recorded hosts elsewhere. Although this species is known to feed on oak in some localities, it has not been seen in the extensive oak woods on the Island.

RECORDS: Tottenville, vii.14.71; Midland Beach, vii.20.71, vii.15.71; Stapleton, vii.17.71.

28. *Limenitis archippus* Cramer. Viceroy

Frequent but local, in springy or marshy open places with small willows. Presumably two-brooded. ("June to September inclusive . . . October 9, 1887") (Davis). The males are highly territorial in mid-afternoon, patrolling 6-10 feet lengths of roadside ditches.

No Staten Island specimens of the very dark-colored form seen at Philadelphia late in the season have been encountered.

HOST PLANTS: Willow (*Salix nigra*) (larvae, Tottenville). Probably poplars and aspens (*Populus* spp.).

RECORDS: Fox Hills, vii.31.70; Travis, vii.12.71; Tottenville, vii.14.71, vii.28.71, viii.18.71; South Avenue, Bloomfield, viii.16.71.

29. *Asterocampa celtis* Boisduval and LeConte. Gray Emperor

Locally abundant at Tottenville and occasional elsewhere, always in groves of the host plant and seldom straying more than a few feet from it. Territorial males perch up to 15 feet above the ground and "defend" a very large area. Both sexes move very abruptly and often pitch upward onto the undersides of leaves, as well as onto people, automobiles, etc.

Two broods, July and September. It is curious that Davis never recorded this distinctive species from the Island.

HOST PLANTS: Hackberry (*Celtis occidentalis*) (larvae, Tottenville).
RECORDS: Wolfe's Pond Park, x.24.70; Mariner's Harbor, vii.1.71; Tottenville, x.5.70, vii.3.71, vii.5.71, vii.14.71, viii.18.71, ix.6.71, ix.22.71.

LIBYTHEIDAE

30. *Libytheana bachmannii* Kirtland. Snout Butterfly

Rare and sporadic, mainly occurring on the south shore. Brush and hedgerows, especially near streams. "Two seen on August 11, 1888 (Richmondtown)" (Davis). Probably breeding here, but its overwintering status is unknown.

HOST PLANTS: Presumably hackberry, as elsewhere.
RECORDS: Great Kills, ix.23.70; Wolfe's Pond Park, x.24.70; Tottenville, vii.14.71.

LYCAENIDAE

31. *Panthiades m-album* Boisduval and LeConte. White M Hairstreak

A single record of this southern species—a fresh male. Status unknown; the White M Hairstreak breeds occasionally in southern Pennsylvania and may do so sporadically here. Recorded north to Connecticut. Borders of oak woods elsewhere.
RECORDS: Oakwood, x.5.71.

32. *Calycopsis cecrops* Fabricius. Red-Banded Hairstreak

Frequent to locally common in the lowlands, mainly in brush on acid sand and visiting roadside flowers. Probably two broods, July and September. Unrecorded by Davis or others before 1950, but now reported from various places in the metropolitan area; perhaps a recent range extension.

HOST PLANTS: Probably winged sumac (*Rhus copallina*) as on Long Island.
RECORDS: Stapleton, vii.1.71; Mariner's Harbor, vii.31.71; Tottenville, viii.18.71, ix.6.71, ix.22.71; Annadale, ix.25.71; South Beach, x.8.71; Midland Beach, x.29.71.

33. *Strymon melinus* Hubner. Gray Hairstreak

Common and general in open places, including vacant lots. Continuously brooded, three or four broods from late April to late October ("May to September," Davis). Spring individuals are small and very dark, but no such tendencies appear in the late fall ones. Our commonest hairstreak, and found in the widest range of habitats.

HOST PLANTS: Clovers (*Trifolium repens, T. arvense*) (ova, Port Richmond and Travis, respectively), bush clover (*Lespedeza capitata*) (ova, larvae, Bloomfield, Midland Beach), sweet clover (*Melilotus alba*) (ova, South Beach), probably other legumes.
RECORDS: Fox Hills, vii.31.70, ix.11.70; New Springville, ix.20.70; Buck's Hollow, x.1.70; Tottenville, x.5.70, vii.3.71, vii.14.71, vii.28.71, viii.18.71, ix.6.71; Port Richmond, x.23.70, iv.24.71; South Avenue, Chelsea, vii.2,71, vii.12.71, viii.16.71; Huguenot, vii.3.71; Arden Heights, vii.5.71; Sea View, vii.16.71, viii.30.71; Midland Beach, vii.20.71, viii.15.71, ix.15.71, x.26.71, x.29.71; Stapleton, viii.17.71, ix.7.71; West New Brighton, ix.21.71; Great Kills, ix.24.71; Travis, ix.29.71; Oakwood, x.5.71, x.28.71; Saint George, x.14.71; New Dorp, x.21.71. (iv.24-x.29)

34. *Harkenclenus titus* Fabricius. Coral Hairstreak

Frequent, locally common on acid sand scrub with small cherries and chokeberries, one brood in July. The males are territorial, perching 2-5 feet

from the ground on tall weeds or twigs. Not seen in the uplands, except one record in Buck's Hollow.

HOST PLANTS: *Prunus serotina*? *Aronia melanocarpa*?

RECORDS: Mariner's Harbor, vii.1.71; Richmond Valley, vii.3.71; Buck's Hollow, vii.4.71; Travis, vii.12,71; South Avenue, Chelsea and Bloomfield, vii.12.71, vii.22.71, vii.27.71; Willowbrook, vii.21.71.

35. *Satyrium acadica* Edwards. Acadian Hairstreak

Very local, known from two marshy spots at Tottenville and one at Willowbrook, associated with *Salix nigra*. A northern species, at or near the southern limit of its range on the coastal plain, not recorded by Davis, and in New Jersey only in the Appalachian highlands (Comstock, 1940). One brood, a bit later than its congeners?

HOST PLANTS: Probably *Salix nigra,* but early stages not seen.

RECORDS: Tottenville, vii.14.71; Willowbrook, vii.21.71.

36. *Satyrium edwardsii* Grote and Robinson. Edwards' Hairstreak

Apparently rare; one taken on acid barrens, South and Merrill Aves., Bloomfield. Should be sought in Woodrow in late June; characteristically emerges a week before the next three species.

HOST PLANTS: Everywhere associated with scrub oak (*Quercus ilicifolia*). This plant was present at the Island collection site.

RECORDS: South Avenue, Bloomfield, vii.12.71.

37. *Satyrium falacer* Godart. Banded Hairstreak.

Abundant in upland oak woods and extremely abundant on dry acid sand on the west shore; absent from swamp (pin oak) forest. One brood, July. Males are territorial in sunlit glades in oak woods but show no aggression when large numbers are densely packed on milkweed or sumac blossoms. This spcies shows considerable minor color and pattern variation.

HOST PLANTS: Associated with white and chestnut oaks (*Quercus alba* and *Q. prinus*).

RECORDS: South Ave., Arlington to Travis, vii.2.71, vii.12.71, vii.22.71; Huguenot, vii.3.71; Richmond Valley, v-i.3.71; Tottenville, vii.3.71, vii.5.71, vii.14.71; Buck's Hollow, vii.4.71; Arden Heights, vii.5.71; Mariner's Harbor, vii.15.71; Willowbrook, vii.16.71, vii.21.71; often by thousands were found. (vii.2-vii.22)

38. *Satyrium caryaevorus* McDunnough. Hickory Hairstreak

Abundant, with the last, usually a bit less numerous but by far the commonest Satyrium on acid sand at Tottenville. Habits as in the last.

HOST PLANTS: Unrecorded locally.

RECORDS: South Avenue, Arlington to Travis, vii.2.71, vii.12.71; Huguenot, vii.3.71; Richmond Valley, vii.3.71; Tottenville, vii.3.71, vii.5.71, vii.14.71; Buck's Hollow, vii.4.71; Arden Heights, vii.5.71; Willowbrook, vii.16.71, vii.21.71 (vii.2-vii.21)

39. *Satyrium liparops* Boisduval and LeConte. Striped Hairstreak

Abundant locally in brush on moist acid sand, closely associated with chokeberry. Males are territorial, perching atop chokeberry bushes. Often on flowers with the two preceding species.

A few individuals have large orange patches above on all wings, resembling the southern populations, but many are as dark as *falacer*.

HOST PLANTS: Black chokeberry (*Aronia melanocarpa*) (ova, Bloomfield), females very often roused by beating this plant.

RECORDS: South Avenue, Bloomfield, Chelsea, and Travis, vii.2.71, vii.12.71, vii.22.71, vii.27.71; Richmond Valley, vii.3.71; Tottenville, vii.4.71, vii.14.71, vii.28.71; Mariner's Harbor, vii.15.71; Willowbrook, vii.16.71, vii.21.71; Arden Heights, vii.5.71. (vii.2-vii.28)

40. *Mitoura gryneus* Hubner. Olive Hairstreak

Extinct, its food plant (*Juniperus virginiana*) reduced to less than a dozen native specimens. "Watchogue, May 8, 1881" (Davis); probably was two-brooded as elsewhere. There are no known extant Staten Island specimens of this hairstreak.

41. *Incisalia augustinus* Westwood. Brown Elfin

Status uncertain. "April and May, formerly common at Watchogue and other sandy portions of the Island, but less plentiful in recent years" (Davis, 1910). A typical Pine Barrens species, looked for but not taken in 1971; specimens, either this species or *I. henrici*, were seen at Chelsea, v.15.71, Mariner's Harbor, v.27.71, and Buck's Hollow, v.5.71. Numbers possibly diminished by the high incidence of fires. In the Pine Barrens, recolonization of burned areas is simple since populations are numerous in the vicinity; the limited habitats on Staten Island make recolonization more difficult, if possible at all.

42. *Incisalia irus* Godart. Frosted Elfin

"April and May . . . Watchogue, near Four Corners, Todt Hill and in the woods between the Black Horse Tavern and Richmond(town)." Frequent on acid sand, near the host plant. Should be looked for in Huguenot and along the Spring Street pipeline cut on Todt Hill, near Reed's Basket Willow Swamp. Brushy borders of woods. One brood.

HOST PLANT: *Baptisia tinctoria* (ova, Bloomfield). The wild indigo is abundant in places along the disturbed embankment of the West Shore Expressway, and *I. irus* can be expected to colonize it if it is not mowed.

RECORDS: South Avenue, Bloomfield and Chelsea, iv.18.71, v.12.71, v.15.71; Mariner's Harbor, iv.21.71.

43. *Incisalia niphon* Hubner. Pine Elfin

"Common on May 8, 1881, along a sandy road at Watchogue. None have been seen since." Almost certainly extinct, its food plants (hard pines, *Pinus rigida* and *P. virginiana*) being reduced to scattered relict trees on the west shore. A univoltine Pine Barrens species. April-June.

44. *Lycaena phlaeas americana* Harris. American Copper

"May to October inclusive" (Davis). Frequent but local on poor and sandy soils. Acid sand, beach sand, and serpentine. Abundant on the mowed meadows at Mount Loretto (Pleasant Plains). Multiple (probably three) broods. The "smeared" form, *fasciata*, taken on South Avenue, v.27.71, and at Tottenville, vii.28.71.

Males are very "pugnacious," attacking even monarchs and large fritillaries.

HOST PLANT: Sheep sorrel (*Rumex acetosella*) (ova, larvae, Midland Beach, Sea View, Pleasant Plains, Port Richmond).

RECORDS: Pleasant Plains, v.10.71, vii.3.71; South Avenue, Chelsea, v.15.71, v.27.71, vii.2.71, vii.12.71; Huguenot, v.26.71; Sea View, vii.4.71, viii.20.71; Charleston, vii.5.71; Willowbrook, vii.16.71; Midland Beach, x.4.71, x.19.71. (v.10-x.19)

45. *Lycaena thoe* Guerin. Bronze Copper

Locally frequent. Wet meadows and marshes, but not noted on the bogs. Two broods, July and September. Davis found this species rare: Clove Valley, vi.20.96, New Springville, ix.12.97; Chelsea, viii.12.10.

HOST PLANT: Associated with curled dock, *Rumex crispus,* in low places.

RECORDS: Travis, vii.12.71; Tottenville, vii.14.71, ix.6.71, ix.22.71; Mariner's Harbor, vii.15.71; Willowbrook, vii.21.71; Graniteville, viii.14.71.

(The Bog Copper, *Lycaena epixanthe* Boisduval and LeConte, was not recorded by Davis but probably formerly occurred on the bogs. It is common on Long Island and in the New Jersey Pine Barrens.)

46. *Everes comyntas* Godart. Tailed Blue

Abundant, waste ground, weedy roadsides, dry old fields and acid scrub, May-late October; at least three broods. Spring forms are large and bright, females with much blue; summer and autumn females brown or black. Males "pugnacious."

HOST PLANTS: *Desmodium canadense* (ova, larvae, Todt Hill); *Lespedeza capitata* (ova, Chelsea); *Trifolium repens* (ova, Port Richmond); perhaps *Melilotus?*

RECORDS: Fox Hills, vii.31.70, ix.11.70, vii.29.71, x.12.71; Willowbrook, ix.6.70; Great Kills, ix.26.70, x.7.70; Tottenville, x.5.70, vii.8.71, vii.28.71, vii.18.-71, ix.22.71, x.6.71; Pleasant Plains, x.10.71; Port Richmond, v.11.71, viii.17.71, ix.3.71, ix.12.71; South Avenue, Arlington to Bloomfield, v.12.71, v.15.71, v.27.71, vii.2.71, vii.22.71, vii.27.71, viii.16.71; Stapleton, v.17.71, vii.1.71, ix.7.71; Mariner's Harbor, vii.1.71, vii.15.71, viii.14.71, x.1.71; Todt Hill, v.18.71; Huguenot, v.26.71; Sea View, vii.4.71, vii.16.71, x.30.71; Charleston, vii.5.71; Midland Beach, vii.20.71, ix.15.71; West New Brighton, ix.21.71; Annadale, ix.25.71; Travis, ix.29.71; Oakwood, x.5.71; Richmondtown, x.13.71; Saint George, x.14.71; New Dorp. x.21.71 (v.11-x.30)

47. *Lycaenopsis argiolus* Linnaeus. Spring Azure

Davis records all three spring forms from the Island, and gives a seasonal range of March to September. In 1971 only one spring specimen (a female *violacea*) was seen although all suitable habitats were searched. The spring flight in Westchester County at the same time was normal. The same situation occurs at Tinicum, near Philadelphia, where summer forms are common but the spring brood is rare or absent. A female *marginata* was, however, taken out of season at Tottenville, ix.6.71.

Summer forms common and widespread in brush, open woods, and gardens; common on overgrown slopes in Stapleton. Probably two summer generations.

HOST PLANTS: Unrecorded on the Island. Flowering dogwood, the usual Piedmont host in spring, is very rare in the wild but maple-leaved viburnum, *V. acerifolium,* and other shrubby viburnums and dogwoods are common in various habitats.

RECORDS: Fox Hills, vii.31.70; Todt Hill, v.14.71; Tottenville, vii.3.71, vii.14.71, vii.28.71, viii.18.71, ix.6.71, ix.22.71; Buck's Hollow, vii.4.71; South Avenue, Bloomfield, vii.12.71, vii.27.71; Mariner's Harbor, vii.15.71; Sea View, vii.16.71; Midland Beach, vii.20.71, viii.15.71, ix.15.71; Stapleton, vii.22.71, viii.17.71. (v.14-ix.22)

LIPHYRIDAE

48. *Feniseca tarquinius* Fabricius. Harvester

Frequent but sporadic, in wet shrubby sites mainly on acid soils; the males defend territories from perches up to 10 feet from the ground on sunlit twigs or leaves and return persistently to the same site when dis-

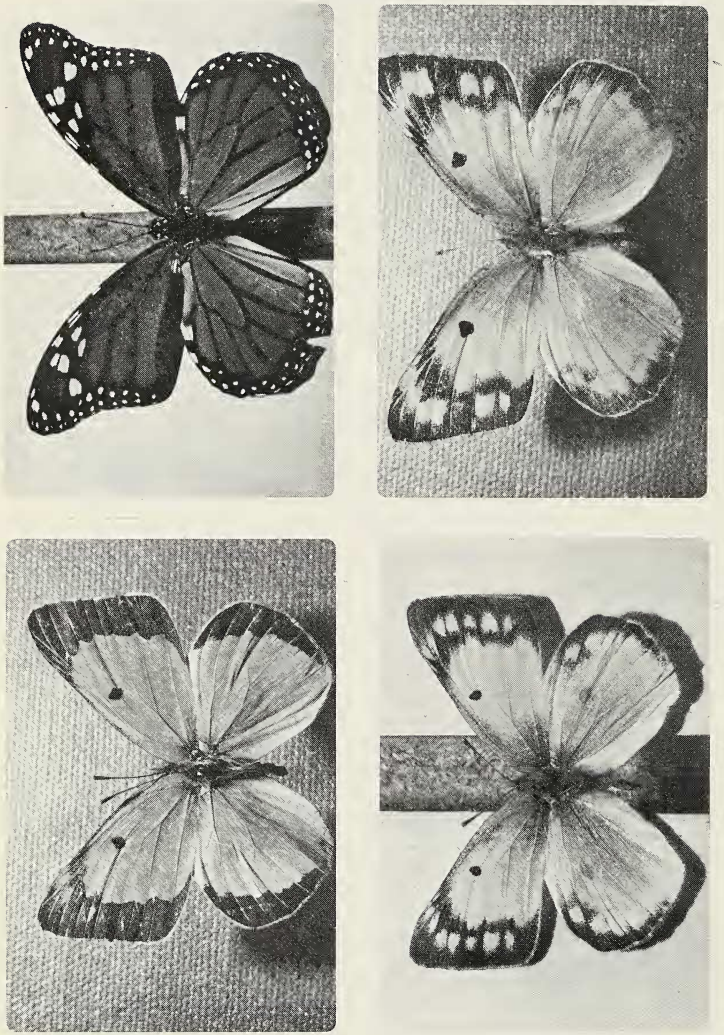

Fig. 11. a, *Colias eurytheme* mosaic gynandromorph, Tottenville, vii.14.71.
b, *C. eurytheme* "blonde" ♀ Oakwood, x.28.71.
c, *Danaus plexippus "megalippe"*-like ♀. Willowbrook, ix.6.70.
d, *C. eurytheme* "chrome yellow" ♀. Tottenville, vii.14.71.

turbed. At least two broods, probably more. "June 21, 1885; August 4, 1907; Woodrow, August 21, 1910."

HOST: Not recorded on Staten Island. Alder, the usual host of the woolly aphids eaten by *F. tarquinius*, is nearly extinct here. Perhaps on woolly aphids of beech or ash.

RECORDS: South Avenue, Chelsea, vii.22.71, viii.16.71; Tottenville, viii.18.71, ix.22.-71; Annadale, ix.25.71.

PAPILIONIDAE

49. *Papilio polyxenes asterius* Stoll. Black Swallowtail

"May to October inclusive," Davis. Common and widespread in open meadows, fields and marshes. The territorial males hilltop and "fly a beat." Extremely variable, individually and seasonally, varying particularly in the width and position of the postmedian yellow hindwing band in the male. Partially triple-brooded.

This species fluctuates greatly in numbers; 1971 was probably a peak year.

HOST PLANTS: Wild carrot (*Daucus carota*) (ova, larvae, many stations).

RECORDS: Fox Hills, vii.31.70, vii.29.71; New Springville, ix.20.70; Travis, v.5.71; Port Richmond, v.11.71, viii.17.71; South Avenue, Chelsea, v.12.71, vii.2.71, vii.12.71, vii.22.71, vii.27.71, viii.16.71; Todt Hill, v.14.71; Huguenot, v.26.71; Mariner's Harbor, vii.1.71; Sea View, vii.4.71, viii.30.-71; Port Ivory, vii.15.71; Midland Beach, vii.20.71; Willowbrook, vii.21.71; Stapleton, vii.22.71; Oakwood, x.5.71. (v.5-x.5)

50. *Papilio glaucus* Linnaeus. Tiger Swallowtail

"May to September inclusive." Frequent to common in open woods, straying widely, commoner on non-acid soils. No fully black females were taken, but two transitional ones were (Arden Heights, vii.5.71; Tottenville, ix.6.71). Double-brooded, the spring flight partly of form "*canadensis*" (Huguenot, v.26.71). The least common of the resident swallowtails on the Island in 1971, but down from 1970 levels.

HOST PLANTS: Black cherry (*Prunus serotina*) (larva, Travis); lilac (*Syringa vulgaris*) (larva, Tompkinsville).

RECORDS: Fox Hills, vii.31.70; Stapleton, v.17.71; Todt Hill, v.18.71; Huguenot, v.26.71; Mariner's Harbor, vii.1.71, viii.14.71; South Avenue, Bloomfield, vii.2.71, vii.12.71; Port Richmond, vii.4.71; Arden Heights, vii.5.71; Willowbrook, vii.21.71; Midland Beach, viii.15.71; Tottenville, viii.18.71, ix.6.71. (v.17-ix.6)

51. *Papilio troilus* Linnaeus. Spicebush Swallowtail

"May to September inclusive" (Davis). Abundant and general in open woods and brush, particularly on acid soils and serpentine; straying to gardens. Exceedingly variable, with a tendency to enlargement of the submarginal spots and to colored tails. Two broods, males of the second with the apical hindwing spot mostly pale green rather than orange above. An avid flower visitor and mud puddle butterfly. Seen *in copula* at Tottenville, vii.28.71 and viii.18.71, 2:40 and 3:20 PM.

HOST PLANTS: Sassafras (*S. albidum*) (larvae abundant, Stapleton); presumably also spicebush (*Lindera benzoin*).

RECORDS: Fox Hills, vii.31.70; Todt Hill, v.14.71; Tottenville, v.25.71, vii.14.71, vii.28.71, viii.18.71, ix.6.71; Huguenot, v.26.71, vii.3.71; Mariner's Harbor, vii.1.71, vii.31.71, viii.14.71; South Avenue, Arlington to Travis, vii.2.71, vii.12.71, vii.22.71, viii.16.71; Buck's Hollow, vii.4.71; Arden Heights, vii.5.71; Port Ivory, vii.15.71; Midland Beach, vii.20.71; Willowbrook, vii.21.71; Wolfe's Pond Park, viii.2.71; Stapleton, viii.17.71. (v.14-ix.6)

52. *Papilio palamedes* Drury. Palamedes Swallowtail

A very rare stray, recorded by Comstock (1940) citing as his source Davis; Fort Wadsworth, vi.18.? (*leg.* Edward J. Burns). The deposition of the specimen is unknown. The only record north of Cape May, N.J.; this butterfly is not known to breed north of the outer coastal plain of Virginia.

53. *Papilio cresphontes* Cramer. Giant Swallowtail

No modern records. "August and September, 1882 . . . a few in 1893. Since that date, it has been observed in the Moravian Cemetery (New Dorp), where there are some bushes of *Ptelea trifoliata,* the food plant of the larva" (Davis). The northern boundary for this species expands and contracts irregularly and it could colonize the metropolitan area again. Two broods near Philadelphia.

54. *Battus philenor* Linnaeus. Pipevine Swallowtail

Rare immigrant. Perhaps colonizing the Island at times though rarely, if ever, overwintering. May 6-November 2 (Davis). There are no native host plants on the Island, and Dutchman's Pipe (*Aristolochia* sp.) is not a very common ornamental.

RECORDS: South Avenue, Bloomfield, vii.22.71; Tottenville, ix.6.71; Mariner's Harbor, x.1.71.

55. *Graphium marcellus* Linnaeus. Zebra Swallowtail

There are no modern records of this species or its food plant (Pawpaw, *Asimina triloba*) anywhere near New York City. Davis gives four records: Bull's Head, vii.5.86; Old Place, vi.30.89; Tottenville, vi.14.02; Concord, viii.5.02.

PIERIDAE

56. *Colias eurytheme* Boisduval. Orange Sulphur, Alfalfa Butterfly (Figs. 11a, b, d)

The most abundant butterfly on Staten Island. Open, disturbed, weedy sites, including dumps, vacant lots, and railroad yards. At least four broods from May to early December; in 1971, the flight continuing well into the winter. Rare in New York City area before about 1930; Davis gives one record of a stray (Richmondtown, October 20, 1900). Mr. Joseph F. Burke took a female in Van Cortlandt Park, New York City, on vii.31.29, now in the S.I. Museum. Well established by 1933, when it flew until November 22 (Davis, 1934).

The short-day phenotype (*"ariadne"*) is common in May and after mid September. Aberrant specimens occur frequently. A mosaic gynandromorph, male but with the apex of the left forewing female, was taken at Tottenville (vii.14.71). "Blonde" and "semialba" females (the former uniform ochreous white, the latter white with an orange discal flush) occur along with the usual white ("alba") ones; the frequency of "alba" is lowest in spring and highest in September and October, which is also the time of peak populations. Hybrids with *Colias philodice* constitute about 8% of captures, not counting "alba" females whose color genotype is concealed. Overwinters as the larva, continuing to feed on mild days and often pupating before spring.

HOST PLANTS: Clovers (*Trifolium pratense, repens*); Sweet clover (*Melilotus alba*); vetch (*Vicia*) (Chelsea, Old Place); alfalfa (*Medicago sativa*) (Willowbrook); all based on numerous collections or observations of ova and larvae.

RECORDS: Fox Hills, vii.31.70, ix.11.70, vii.29.71, ix.16.71, x.12.71, xi.16.71, xi.28.71, xii.10.71, xii.11.71, xii.13.71; Port Richmond, ix.7.70, x.19.70, x.20.70, x.23.70, x.24.70, xi.1.70, xi.3.70, xi.8.70, xi.9.70, xi.14.70, xi.19.-70, xi.21.70, xii.2.70, viii.17.71, ix.12.71, xi.2.71, i.4.72; Richmondtown, ix.13.70, x.13.71; New Springville, ix.20.70; Great Kills, ix.23.70, ix.26.70, ix.24.71; Buck's Hollow, x.1.70; Tottenville, x.5.70, vii.5.71, vii.14.71, vii.28.71, viii.18.71, x.6.71; Wolfe's Pond Park, x.24.70, viii.2.71; Graniteville, x.28.70; Old Place, xi.7.70; South Avenue, Chelsea, v.5.71, v.12.71, v.15.71, vii.2.71, vii.12.71, vii.22.71, vii.27.71, viii.16.71; Travis, v.5.71, ix.29.71; Pleasant Plains, v.10.71, vii.3.71; Todt Hill, v.14.71, vii.4.71; Stapleton, vii.1.71, viii.17.71, ix.7.71, xi.5.71; Mariner's Harbor, vii.1.71, vii.15.71, x.1.71, x.27.71; Charleston, vii.5.71; Sea View, vii.16.71, viii.30.71, x.30.71; Willowbrook, vii.21.71, x.16.71; Midland Beach, vii.15.71, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71, x.29.71, xi.4.71, xi.6.71, xi.17.71, xi.28.71, xii.16.71; West New Brighton, ix.21.71; Annadale, ix.25.71; Oakwood, x.5.71, x.28.71, xi.18.71; South Beach, x.8.71, xi.19.71; Saint George, x.14.71; New Dorp, x.21.71; Fort Wadsworth, xii.16.71, xii.21.71, i.3.72. Form "alba" at virtually all stations, dates v.12.71-xii.2.70. "Blonde" females, Fox Hills, vii.31.70 (in Cornell University collections); Midland Beach, ix.5.71; Oakwood, x.28.71. "Semi-alba" females common after mid-vii. Hybrids, both sexes, collected as follows: New Springville, ix.20.70; Great Kills, ix.23.70, ix.24.71; Port Richmond, x.24.70, xi.1.70, xi.8.70, xi.9.70, xi.14.70, v.11.71, xi.2.71; Travis, v.5.71; Todt Hill, v.14.71; South Avenue, Chelsea, v.15.71, vii.2.71, vii.12.71, vii.22.71, vii.27.71; Mariner's Harbor, vii.15.71, x.1.71; Tottenville, vii.27.71; Midland Beach, viii.15.71, ix.15.71; Fox Hills, ix.16.71; Annadale, ix.25.71; New Dorp, x.21.71. (v.5-i.4)

57. *Colias philodice* Latreille. Common or Yellow Sulphur

Common and widespread in open country, preferring moister sites than the more abundant Orange Sulphur. "April-December 6 (1891)" (Davis). Probably four broods. For hybrids, see under *C. eurytheme*, above. The short-day phenotype (*"anthyale"*) well-developed in April-May and September-November. White females not always distinguishable from the preceding; more frequent than white *eurytheme* in spring? A "chrome yellow" female with the pattern of *eurytheme*, taken at Tottenville vii.14.71, is probably that species rather than *philodice*.

HOST PLANTS: Clovers (*Trifolium repens* and *pratense*) (many records; ova, larvae); perhaps other legumes.

RECORDS: Fox Hills, vii.31.70, ix.11.70, iv.24.71, vii.29.71, ix.16.71, x.12.71; Great Kills, ix.26.70, ix.24.71; Port Richmond, x.20.70, xi.1,70, xi.3.70, xi.8.70, xi.14.70, ix.24.71, v.11.71, ix.12.71; Wolfe's Pond Park, x.24.70; Graniteville, x.28.70; Old Place, xi.3.70; Eltingville, iv.25.71; Sout Avenue, Chelsea and Bloomfield, v.5.71, v.12.71, v.15.71, vii.2.71, vii.12.71, vi.22.71, vii.27.71; Travis, v.5.71, ix.29.71; Pleasant Plains, v.10.71, vii.3.71; Todt Hill, v.14.71, vii.4.71; Stapleton, vii.1.71, ix.7.71; Mariner's Harbor, vii.1.71, vii.15.71, x.1.71; Buck's Hollow, vii.4.71; Charleston, vii.5.71; Willowbrook, vii.16.71, vii.21.71; Midland Beach, vii.20.71, ix.15.71, x.4.71, x.19.71, x.26.71, x.29.71; Annadale, ix.25.71; Oakwood, x.5.71; Tottenville, x.6.71; Richmondtown, x.13.71; New Dorp, x.21.71; Sea View, x.30.71. Dates for form "alba," iv.24.71-x.26.71. (iv.24-xi.14)

58. *Colias* (*Zerene*) *caesonia* Stoll. Dog Face

The only records near New York City are given by Davis: Eltingville and Kreischerville (=Charleston), summer 1896, apparently frequent and perhaps breeding. This southern species occasionally immigrates into the northeast and may set up temporary colonies there, but cannot overwinter. The usual food plant, *Amorpha*, grows today in Woodrow and Willowbrook.

59. *Phoebis sennae eubule* Linnaeus. Cloudless Sulphur

No modern records. "Usually appears in September about the middle of the month, and in some years is quite common. Two specimens . . . at Tottenville, October 4, 1903." A coastal migrant recorded in numbers north to eastern Massachusetts; regularly reaching the New Jersey shore in autumn. Should be looked for on the south shore beaches. Not known to breed north of Virginia.

60. *Eurema nicippe* Cramer. Sleepy Orange

Irregular immigrant, breeding often, but its overwintering status in doubt. In 1971 at least two broods on the sandy west shore from Mariner's Harbor to Tottenville. Davis records flights in 1880, 1891, 1896, 1906, 1907, and 1910, May-October, breeding in the Clove Valley on *Cassia marilandica* (this plant is not known at present on Staten Island). His surviving specimens are dated v.10.96, vi.24.06, x.4.91, v.30? and "1880."

HOST PLANTS: Perhaps partridge peas (*Cassia nictitans*).

RECORDS: Mariner's Harbor, vii.1.71; Charleston, vii.5.71; South Avenue, Bloomfield, vii.12.71, vii.22.71; Tottenville, ix.22.71.

61. *Eurema lisa* Boisduval and LeConte. Little Sulphur

"July to October inclusive. Most common on the sandy portions of the Island" (Davis). Common and widespread in open sandy fields and beaches, 1970, but completely absent in 1971. Probably a regular immigrant, breeding but not usually overwintering. The white female form not recorded locally.

HOST PLANTS: Wild sensitive plant or partridge pea, *Cassia nictitans* (ova, larvae, Graniteville).

RECORDS: New Springville, ix.20.70; Great Kills, ix.23.70, ix.26.70, x.7.70; Buck's Hollow, x.1.70; Port Richmond, x.23.70, x.24.70, xi.1.70, xi.3.70; Wolfe's Pond Park, x.24.70.

62. *Pieris rapae* Linnaeus. European Cabbage Butterfly

Abundant and general in open places, including gardens and vacant lots. April-November, the spring and last fall specimens of the cold weather phenotype with reduced black above, but heavily dusted beneath. The female form "fasciata," with the discal forewing spots fused, taken at Oakwood, xi.5.71. In mild years probably flying as early as mid-March; "March-November," Davis. The Davis collection contains one dated III.29.03.

Probably four broods, changing host plant as the seasonal succession of weedy Cruciferae occurs.

HOST PLANTS: (All ova and larvae, many records on the Island) Cruciferae: *Lepidium virginicum, Barbarea vulgaris, Brassica nigra, B. oleracea, Eruca sativa, Sisymbrium officinale* var. *leiocarpum, S. altissimum.* Overwinters as diapausing pupae, but living larvae were found on *Barbarea* as late as i.4.72.

RECORDS: Fox Hills, vii.31.70, iv.24.71, v.24.71, x.12.71; New Springville, ix.20.70; Tottenville, x.5.70, vii.4.71; vii.28.71, x.6.71; Port Richmond, x.23.70, xi.1.70, xi.3.70, xi.8.70, ix.17.71, iv.21.71, iv.24.71, v.5.71, ix.3.71, ix.12.71, ix.27.71, xi.2.71; Wolfe's Pond Park, x.24.70; Graniteville, x.28.70; Old Place, xi.7.70; Mariner's Harbor, iv.11.71, vii.2.71, viii.14.71, x.27.71; Travis, iv.18.71, v.5.71, ix.29.71; Stapleton, iv.19.71, iv.24.71, v.17.71, vii.1.71; South Avenue, Bloomfield, v.5.71, v.15.71, v.27.71, vii.22.71; Latourette Park, v.5.71; Pleasant Plains, v.10.71; Todt Hill, v.14.71; Port Ivory, vii.15.71; Sea View, vii.16.71, x.30.71; Midland Beach, vii.20.71, vii.15.71, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71, x.29.71, xi.4.71, xi.6.71, xi.17.71; Willowbrook, vii.21.71, x.16.71; West New Brighton, ix.21.71; Great Kills, ix.24.71; Annadale, ix.25.71; Oakwood, x.5.71, x.28.71, xi.5.71; South Beach, x.8.71; Richmondtown, x.13.71; Saint George, x.14.71; New Dorp, x.21.71. (iv.11-xi.17)

63. *Pieris protodice* Boisduval and LeConte. Checkered White

June-September, and April 19, 1902 (Davis records). Locally common to abundant on disturbed sandy soils, most numerous on the coastal plain and absent from the hills. April-November, the short-day phenotype (*vernalis* Edwards) at both ends of the flight; four broods, perhaps not always

wintering successfully even on the south shore, and in any case certainly bolstered by immigration. The Davis collection contains Island specimens dated viii.27 and ix.6 (no year) and a female *vernalis*, x.15.12.

HOST PLANTS: Peppergrass (*Lepidium virginicum*) (many ova and larvae, Midland Beach).

RECORDS: New Springville, ix.20.70; Great Kills, ix.23.70, ix.24.71; Wolfe's Pond Park, x.24.70; Graniteville, x.28.70; Port Richmond, xi.1.70, xi.9.70, iv.21.71; Stapleton, iv.19.71; South Avenue, Chelsea, viii.16.71; Midland Beach, ix.8.71, ix.15.71, x.4.71, x.19.71, x.26.71, xi.17.71, xi,28.71; West New Brighton, ix.21.71; Tottenville, ix.22.71, x.6.71; Annadale, ix.25.71; Travis, ix.29.71; Oakwood, x.5.71, xi.18.71; South Beach, x.8.71, xi.19.71; Fox Hills, x.12.71. (iv.19-xi.28)

(The Falcate Orange Tip, *Anthocaris midea* Hubner, while frequent in upland woods north of New York City and also in the Pine Barrens, has never been recorded from Staten Island.)

HESPERIIDAE

64. *Epargyreus clarus* Cramer. Silver-Spotted Skipper

Common and general in brushy open woods or thickets, wherever small plants of the host grow. Strays to gardens. Larvae common, the easiest skipper larvae to find. Males are territorial, adopting perches 3-10 feet above the ground.

Two broods, May and August.

HOST PLANTS: Black locust (*Robinia pseudoacacia*) (larvae, Stapleton, Charleston).

RECORDS: Fox Hills, vii.31.70; Huguenot, v.26.71, vii.3.71; Stapleton, vii.1.71, ix.7.71; South Avenue, Chelsea, vii.2.71, viii.16.71, ix.1.71; Sea View, vii.16.71; Willowbrook, vii.21.71; Tottenville, vii.28.71, ix.6.71; Port Richmond, viii.17.71. (v.26-ix.7)

65. *Achalarus lycidas* Geyer. Hoary Edge

Locally common on sandy soils with the food plants, in both upland and lowland situations in brushy fields and open woods. Males territorial, seldom perching more than four feet high. One brood, "May, June, July" (Davis).

HOST PLANTS: *Desmodium* species (larvae, Todt Hill; ova, Huguenot).

RECORDS: Stapleton, vii.1.71; South Avenue, Bloomfield, vii.2.71; Huguenot, vii.3.71; Tottenville, vii.3.71, vii.14.71; Todt Hill, vii.4.71; Buck's Hollow, vii.4.71; Willowbrook, vii.21.71.

66. *Thorybes pylades* Scudder. Northern Cloudy Wing

One record on acid scrub. The usual food plants, *Lespedeza* and *Desmodium*, are common and 1971 may have been a poor year for the species. Should be sought on acid sand and serpentine in brush and open woods, June (-July, Davis).

RECORDS: South Avenue, Bloomfield, vii.12.71.

67. *Thorybes bathyllus* Smith and Abbott. Southern Cloudy Wing

"May, June, and July" (Davis). No modern records. A species of sandy soils, feeding on *Desmodium* (preferring *D. rotundifolium*, not seen on Staten Island). Single-brooded in central New York, double-brooded at Philadelphia. There is no obvious reason for the absence of this species today; it should be sought on the west shore in June.

68. *Pholisora catullus* Fabricius. Sooty Wing

Very common on vacant lots and by weedy roadsides, and on the Fresh Kills landfill. Infrequent elsewhere. A species closely associated with man and his works. Two broods, May and July, with a partial third in mid-late August.

HOST PLANTS: Pigweeds (*Amaranthus* spp.), Lamb's Quarters (*Chenopodium album*) (larvae common, Stapleton, Port Ivory, Charleston).

RECORDS: Fox Hills, vii.31.70, v.24.71; Stapleton, v.17.71, vii.1.71, ix.7.71; Huguenot, v.26.71; Sea View, vii.4.71, viii.16.71; South Avenue, Arlington, vii.12.71; Tottenville, vii.14.71, vii.28.71; Mariner's Harbor, vii.15.71; Midland Beach, vii.20.71, vii.15.71. (v.17-ix.7)

69. *Pyrgus communis* Grote. Checkered Skipper

"August, September, and October at Tottenville, and one near (New Springville), September 8, 1895" (Davis). No modern records. The checkered skipper is an irregular immigrant into the New York area, occasionally breeding and overwintering. Two food plants, *Malva neglecta* and garden hollyhock, *Althaea officinalis,* are common on the Island and could sustain breeding if females arrived in late summer.

70. *Erynnis icelus* Scudder and Burgess. Dreamy Dusky Wing

Frequent in brush and open woods on serpentine and acid sand. One brood, May-June. The only dusky wing which flies into dense brush when alarmed.

HOST PLANTS: Gray birch (*Betula populifolia*)? Big-tooth Aspen (*Populus grandidentata*)?

RECORDS: Todt Hill, v.14.71, v.18.71; Sea View, v.18.71; Huguenot, v.24.71; South Avenue, Bloomfield, v.27.71.

71. *Erynnis brizo* Boisduval and LeConte. Sleepy Dusky Wing

"April, May, and June, on the more barren hills and sandy districts" (Davis). A typical Pine Barrens species which should occur on the west shore lowlands, at Woodrow and at Tottenville, but not observed in 1971. Should be looked for, especially near the usual host plant, scrub oak (*Quercus ilicifolia*).

72. *Erynnis martialis* Scudder. Mottled Dusky Wing

"Clove Valley, v.3.02; Reed's Valley (Todt Hill), viii.10.09" (Davis). One taken near Susan Wagner High School, Sea View, on serpentine in open brushy woods. Should be sought near the usual host plant, *Ceanothus* (a rare plant on the Island today, noted only on Todt Hill, at Sea View, and in Huguenot). Bivoltine in New Jersey.

RECORDS: Sea View, vii.16.71.

73. *Erynnis horatius* Scudder and Burgess. Horace's Dusky Wing

Frequent in and near oak woods at all elevations. Apparently three-brooded, May to September. Unreported by Davis, probably through confusion with the next species. The only *Erynnis* seen in pin oak swamp forest.

HOST PLANTS: Not known, presumably some species of oak.

RECORDS: South Avenue, Chelsea, v.5.71, vii.12.71; Todt Hill, v.18.71; Tottenville, vii.14.71; Mariner's Harbor, vii.15.71; Stapleton, ix.7.71.

74. *Erynnis juvenalis* Fabricius. Juvenal's Dusky Wing, Common Dusky Wing

Abundant in oak woods and scrub at all elevations, but absent from pin oak swamp forest. Single-brooded, flying in May; Davis' record of "early May to October" was undoubtedly based on confusion with the preceding species. The males are territorial along wood roads. A pair taken *in copula*, Todt Hill, v.14.71 at 3:30 p.m. in shade by a roadside.

HOST PLANTS: White and post oaks (*Quercus alba, stellata*) (larvae, Bloomfield), perhaps other oaks.

RECORDS: South Avenue, Arlington to Travis, v.5.71, v.12.71, v.15.71, v.27.71; Latourette Park, v.5.71; Pleasant Plains, v.10.71; Todt Hill, v.14.71, v.18.71.

75. *Erynnis baptisiae* Forbes. Wild Indigo Dusky Wing

Infrequent, sporadic. Brushy sites on acid sand or serpentine, but not noted as especially frequenting the vicinity of the supposed host plant, *Baptisia;* visits dogbane and other roadside flowers. Two broods, May and July. Davis' specimens are lost, but his record of *E. persius*, "May to September inclusive," almost certainly refers to this species.

HOST PLANTS: Not recorded on Staten Island.

RECORDS: Huguenot, v.26.71; Willowbrook, vii.21.71; Tottenville, vii.28.71.

76. *Ancyloxipha numitor* Fabricius. Least Skipper

Common and widespread. Wet meadows, ditches, edges of ponds and marshes, and vacant lots, often flying below the top of the grass. Two broods, July and August-October, second brood individuals generally larger and darker than first.

HOST PLANTS: Cutgrass, *Leersia oryzoides* (larvae, Travis, Sea View), probably other grasses.

RECORDS: Fox Hills, vii.31.70; Willowbrook, ix.6.70, vii.21.71; Stapleton, vii.1.71, ix.7.71; South Avenue, Chelsea, vii.12.71, vii.27.71, ix.1.71; Port Ivory, vii.15.71; Wolfe's Pond Park, viii.2.71; Midland Beach, viii.15.71; Sea View, viii.30.71; West New Brighton, ix.21.71; Mariner's Harbor, x.1.71; Tottenville, x.6.71. (vii.1-x.6)

77. *Thymelicus lineola* Ochsenheimer. European Skipper

Common to locally abundant in grassy meadows, old fields, and vacant lots; absent from serpentine barrens. Most numerous at Mount Loretto, visiting bird's-foot trefoil blossoms. A recent introduction in the New York City area (Shapiro, 1971). The white form has not been observed. One brood, June-July.

HOST PLANTS: Timothy (*Phleum pratense*) (ova, Pleasant Plains), perhaps other introduced grasses.

RECORDS: Stapleton, vii.1.71; Mariner's Harbor, vii.1.71; South Avenue, Arlington, vii.2.71; Pleasant Plains, vii.3.71; Tottenville, vii.3.71; Sea View, vii.4.71; Arden Heights, vii.5.71; Port Ivory, vii.15.71.

78. *Hesperia sassacus* Harris. Indian Skipper

"May and June" (Davis). Not seen in 1971. Should be looked for on serpentine barrens and on sandy soils.

79. *Hesperia leonardus* Harris. Leonard's Skipper

"One female collected at Mariner's Harbor on September 25, 1887 and one male on Todt Hill, September 22, 1888." One modern record, taken on a Joe-Pye weed blossom in brush along Clermont Avenue, Tottenville.

Should be fairly widespread on acid soils. Single-brooded throughout its range, in late summer.
RECORDS: Tottenville, ix.22.71.

80. *Hesperia attalus* Edwards. Attalus Skipper

One record on serpentine barrens. A rare species; in southern New Jersey associated with extensive stands of switchgrass (*Panicum virgatum*). Breeding status unknown.
RECORDS: Sea View, vii.16.71.

81. *Hesperia metea* Scudder. Cobweb Skipper

Common or locally abundant on serpentine barrens, and less frequently on wet, acid sandy soils and around the bogs. One brood, May. The males are territorial, perching on bare ground among the tufts of bluestem. Recorded from Tottenville, June (Davis) but not seen there in 1971.

HOST PLANTS: Little bluestem (*Andropogon scoparius*) on serpentine and bunchtop bluestem (*A. glomeratus*) on bogs. On the former, larva constructs a nest of a rolled leaf or leaves at the crown; when in diapause occupies a partly subterranean nest in which it is able to withstand light ground fires, which are frequent on the barrens. (Larvae, Richmondtown, Chelsea).

RECORDS: South Avenue, Arlington to Bloomfield and Chelsea, v.12.71, v.15.71, v.27.71; Travis (on diabase), v.27.71; Richmondtown, v.18.71.

82. *Hylephila phylaeus* Drury. Fiery Skipper

Frequent after early August in a variety of open situations, even on lawns; probably a regular immigrant, overwintering rarely, if ever. Not recorded by Davis. Late-season specimens have heavier patterns on the hindwing beneath.

HOST PLANTS: Unrecorded.

RECORDS: Wolfe's Pond Park, viii.2.71; Tottenville, viii.18.71, ix.22.71; Port Richmond, ix.6.71; Midland Beach, ix.15.71, x.29.71; Graniteville, viii.17.71; Fox Hills, ix.16.71; Annadale, ix.25.71; Oakwood, x.5.71, x.28.71, xi.5.71.

83. *Atalopedes campestris* Boisduval. The Sachem

A rare stray from the south, not recorded by Davis. One record.
RECORDS: Oakwood, x.28.71.

84. *Polites verna* Edwards. Glassy Wing

"June, July, and August" (Davis). Frequent and widespread in brushy places, open woods, and old fields; usually seen on blossoms of common milkweed. One brood; the host plant not known but certainly a grass.

RECORDS: South Avenue, Chelsea and Bloomfield, vii.2.71, viii.22.71; Huguenot, vii.3.71; Pleasant Plains, vii.3.71; Tottenville, vii.4.71, vii.14.71; Charleston, vii.5.71; Arden Heights, vii.5.71; Sea View, vii.16.71, vii.21.71.

85. *Polites manataaqua* Scudder. Cross-line Skipper

Frequent in dry grassy areas, locally very abundant on serpentine barrens at Sea View. Apparently single-brooded in July ("May-July," Davis), although it is clearly double-brooded at Philadelphia and partially so in central New York.

HOST PLANTS: Not recorded. Although commonly found on serpentine, this species does not seem to be an *Andropogon* feeder.

RECORDS: Stapleton, vii.1.71; South Avenue, Arlington, vii.2.71, vii.12.71; Sea View, vii.4.71, vii.16.71; Port Ivory, vii.15.71; Willowbrook, vii.16.71, vii.21.71.

86. *Polites themistocles* Latreille. Tawny-Edged Skipper

"May to September inclusive" (Davis), probably including the preceding species. Infrequent and sporadic, mostly as singletons on flowers in open grassy places, even on vacant lots growing up to asters. Two broods, July and September. Not yet found with *P. manataaqua* on Staten Island. At Philadelphia that species tends to occur upslope of *P. themistocles* where they are found contiguously.

HOST PLANTS: Unknown. Presumably a grass.

RECORDS: Latourette Park, ix.6.70; Huguenot, vii.3.71; Buck's Hollow, vii.4.71; South Avenue, Chelsea, vii.12.71; Willowbrook, vii.21.71.

87. *Polites peckius* Kirby. Peck's Skipper

Common and widespread in moist grassy sites and vacant lots, seemingly regardless of soils, but not on extensive bluestem (serpentine) barrens. Probably partially three-brooded, May to September. Host not recorded locally.

RECORDS: Richmondtown, ix.13.70; South Avenue, Arlington to Travis, v.27.71, vii.2.71, viii.16.71, ix.1.71; Stapleton, vii.1.71, viii.17.71, ix.7.71; Huguenot, vii.3.71; Pleasant Plains, vii.3.71; Tottenville, vii.14.71; Wolfe's Pond Park, viii.2.71; Mariner's Harbor, viii.14.71; Midland Beach, viii.15.71, ix.8.71; Port Richmond, viii.17.71; Sea View, viii.30.71. (v.27-ix.13)

88. *Polites mystic* Scudder. Long Dash

Scarce and local, recorded on one of the west shore bogs and in a wet meadow on acid sand; apparently one-brooded. Reported by Davis for June; not fresh in July, 1971. At the latitude of New York City, this species may be partially double-brooded, at least some years.

HOST PLANTS: Not known.

RECORDS: South Avenue, Bloomfield, vii.12.71; Tottenville, vii.14.71.

89. *Polites vibex* Geyer. Whirlabout

This southern species was a frequent immigrant on the south shore in the fall of 1971, though not seen in 1970. It flies with the similarly colored Fiery Skipper. Unreported previously for the New York area, although it fairly often reaches Philadelphia on the coastal plain. Breeding status doubtful.

RECORDS: Tottenville, viii.18.71, ix.22.71; Midland Beach, x.26.71, xi.4.71; Oakwood, x.28.71.

90. *Wallengrenia egeremet* Scudder. Broken Dash

Common and widespread in brushy old fields on a variety of soils; not found in bluestem or switchgrass areas. July ("June-August," Davis), one brood only.

HOST PLANTS: Associated with *Panicum clandestinum,* Willowbrook.

RECORDS: Stapleton, vii.1.71; South Avenue, Arlington to Travis, vii.2.71, vii.12.71, vii.22.71; Tottenville, vii.3.71, vii.14.71, vii.28.71; Sea View, vii.4.71, vii.16.71; Todt Hill, vii.4.71; Buck's Hollow, vii.4.71; Charleston, vii.5.71; Arden Heights, vii.5.71; Willowbrook, vii.16.71, vii.21.71; Midland Beach, vii.20.71. (vii.1-vii.28)

91. *Poanes viator* Edwards. Broad-Winged Skipper

This is the most abundant skipper on Staten Island and in the New York metropolitan area, although it is quite local. Known to Davis only from Dongan Hills, "not uncommon . . . salt meadows." Its food plant locally, reed, now covers vast areas of hydraulic landfills and disturbed tidal marsh and here *Poanes viator* breeds by literal millions where no other butterflies are found. It has colonized patches of reed at all eleva-

tions. Our populations are subspecies *zizaniae* Shapiro, characterized by large size and trimorphic ventral hindwing pattern. One brood, July-August.

HOST PLANTS: Reed (*Phragmites communis*) (ova, larvae, Midland Beach). The host of *P. v. zizaniae* at Philadelphia, Wild Rice (*Zizania*), does not grow on Staten Island.

RECORDS: South Avenue, Chelsea bogs, vii.2.71, vii.12.71, vii.22.71, vii.27.71; Tottenville, vii.5.71, vii.14.71, vii.28.71, viii.18.71; Charleston, vii.5.71; Arden Heights, vii.5.71; Travis, vii.12.71; Mariner's Harbor, vii.15.71, vii.31.71; Graniteville, vii.15.71; Port Ivory, vii.15.71; Willowbrook, vii.16.-71, vii.21.71; Sea View, vii.16.71; Midland Beach, vii.20.71; Fox Hills, vii.29.71. (vii.2-viii.18)

92. *Poanes massasoit* Scudder. Mulberry Wing

Local, restricted to the west shore bogs where it is associated with tussock sedge (*Carex stricta*). Frequent, a single brood in July. "Meadows near the foot of New Dorp Lane, August 8, 1885 . . . plentiful near Bull's Head, July 19, 1891." This species was certainly commoner and more widespread in Davis' day; it is still abundant in the Hudson Valley and in the New Jersey Pine Barrens.

HOST PLANTS: Probably *Carex stricta.*

RECORDS: South Avenue bogs, Chelsea and Bloomfield, vii.12.71, vii.22.71, vii.27.71; Woodrow bog, vii.27.71.

93. *Poanes hobomok* Harris. Northern Golden Skipper

"May, June, and July." Probably frequent in open woods at all elevations, but few captures were made in 1971 and none of the dark female. One brood.

HOST PLANTS: Usually associated with *Panicum* spp.; not reared locally.

RECORDS: Stapleton, vii.1.71; Tottenville, vii.14.71.

94. *Poanes zabulon* Boisduval and LeConte. Southern Golden Skipper

Frequent and widespread in brushy old fields, along hedgerows and woods edges, and in rankly overgrown city lots. Two broods, July and mid-August-September ("May, June; August-October," Davis). The territorial males take up perches on sunlit leaves and twigs in woods, 3-10 feet above the ground. Females are more often found in brush and undergrowth. Host plant and early stages unknown on the Island.

RECORDS: Fox Hills, v.24.71; Stapleton, vii.1.71, viii.17.71; Tottenville, vii.3.71, viii.18.71, ix.6.71; Buck's Hollow, vii.4.71; Midland Beach, viii.15.71, ix.8.71, ix.15.71; South Avenue, Chelsea, viii.16.71; Sea View, viii.30.71. (v.24-ix.15)

95. *Atrytone arogos* Boisduval and LeConte. Arogos Skipper

Known only from the serpentine barrens area at the intersection of Bradley and Brielle Avenues, Sea View; there quite common, easily taken on blue vetch, clover, Canada thistle and dogbane flowers. One brood in July. Staten Island is the northernmost record of this little-known insect.

HOST PLANTS: Little bluestem, *Andropogon scoparius;* accepts *A. glomeratus.* Reared from ova deposited by captive females; not surviving on other grasses from the collection site. Constructs a rolled and tied leaf nest. Diapauses 2/3 grown.

RECORDS: Sea View, vii.4.71, vii.16.71, vii.21.71 (R. Pine).

96. *Atrytone logan* Edwards. Delaware Skipper

Three localities at Tottenville in brush, frequent; one brood in July.

Not recorded by Davis. At Philadelphia an *Andropogon* feeder, but not found on serpentine here. Visits tall roadside flowers freely; males pugnacious, territorial.
RECORDS: Tottenville, vii.3.71, vii.5.71, vii.14.71.

97. *Euphyes dion* Edwards. Dion Skipper

One of each sex taken on a bog at South near Merrill Avenue. Probably a sedge feeder. In central New York this species usually maintains a very low population density; the males are intensely territorial. Definitely to be considered an "endangered species" on Staten Island.
RECORDS: South Avenue, vii.12.71.

98. *Euphyes conspicua* Edwards. Black Dash

A single specimen—a fresh male—taken on a buttonbush (*Cephalanthus*) blossom with *P. viator* in the same vicinity as the last. This species is usually associated with *P. massasoit* and tussock sedge (*Carex stricta*). Formerly widespread on the Island: "July, August" (Davis).
RECORDS: South Avenue, vii.2.71.

99. *Euphyes bimacula* Grote and Robinson. Two-Spotted Skipper

One female taken with the two *E. dion* on a bog in Bloomfield, 1971. In central New York feeds on stoloniferous sedges, e.g., *Carex trichocarpa* (this species not known on the Island). Common on bogs in the New Jersey Pine Barrens. No old records.
RECORDS: South Avenue, vii.12.71.

100. *Euphyes ruricola metacomet* Harris. Eastern Dun Skipper

Infrequent. Brushy areas and open woods, not seen on acid soils or serpentine. Recorded by Davis for "June, July" and taken in 1971 from July to September, the evidence for a second brood weak although this insect is clearly two-brooded at Philadelphia. Host plants not known locally; presumably grasses.
RECORDS: Tottenville, vii.14.71; Willowbrook, vii.16.71; Wolfe's Pond Park, vii.2.71; Annadale, ix.25.71.

101. *Lerema accius* Abbott and Smith. Clouded Skipper

Infrequent to rare immigrant, taken in weedy sites on flowers on the south shore in autumn; not seen in 1970. Breeds in New Jersey some years on *Paspalum* sp., but not known to breed or overwinter here.
RECORDS: Tottenville, ix.22.71; South Beach, x.8.71.

102. *Atrytonopsis hianna* Scudder. Dusted Skipper

Seen (but not taken) on serpentine-limonite barrens, Fox Hills. Probably frequent in such habitats in June; should be looked for wherever *Hesperia metea* occurs. At Philadelphia, one brood in May, the host plant *Andropogon scoparius.*
RECORDS: Fox Hills, v.24.71.

103. *Nastra lherminier* Latreille. Swarthy Skipper

Frequent, to locally abundant on serpentine or sand with the host plant. Open grasslands and brushy situations. Two broods, June-July and August-September; reported by Davis, Tottenville, vi.20.97. There is no reason to doubt that this species overwinters every year on Staten Island.

HOST PLANTS: Little bluestem, *Andropogon scoparius* (ova, Sea View, Travis.)

RECORDS: New Springville, ix.20.70; Stapleton, vii.1.71; Mariner's Harbor, vii.1.71; Huguenot, vii.3.71; Midland Beach, vii.20.71; Tottenville, viii.18.71; Sea View, viii.30.71; Richmondtown, viii.30.71; South Avenue, Travis, ix.1.71.

104. *Panoquina panoquin* Scudder. Salt-Marsh Skipper

Infrequent, restricted to salt meadows on the west shore, where it is seemingly two-brooded (early July, August-September). This species probably suffers from spraying against salt-marsh mosquitoes.

HOST PLANTS: Closely associated with a salt marsh grass, *Distichlis spicata.*

RECORDS: South Avenue, Bloomfield and Chelsea, viii.16.71; Charleston, vii.5.71; Old Place, ix.1.71; Fresh Kills, ix.1.71.

105. *Panoquina ocola* Edwards. Long-Winged Skipper

Irregular immigrant, late in the season on the south shore. Annadale, September 1896 (R. D. Wainwright, reported in Davis). Modern records are from both 1970 and 1971, but there is no evidence of breeding locally. Five were taken at Midland Beach, xi.1.71, but none was in good condition. Visit asters and other late flowers freely.

RECORDS: Wolfe's Pond Park, x.24.70; Midland Beach, xi.1.71.

Species of Uncertain Determination (Pieridae)

106. *Pieris napi oleracea* Harris. Grey-Veined White, Mustard White

Recorded by Davis on the basis of Grote's recollection of taking this species on Staten Island between 1856-1859. *P. n. oleracea,* a Canadian Zone species, occurs in the Catskills and has been reported for the Appalachian highlands of northwestern New Jersey. The similar West Virginia White, *P. virginiensis* Edwards, is a Transition Zone species ranging as close to New York City as Westchester County. The host plants of *P. virginiensis,* toothworts (*Dentaria*), still reportedly occur on Staten Island but are very local; we have not seen them. No New York metropolitan area specimens that could be referred to either *Pieris* species are known to exist today.

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Finally, a special debt is owed the many enthusiastic students at Richmond College who slogged through bogs and clambered over sandhills every Friday afternoon in the name of science.

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Fig. 12. Map of Staten Island localities. (See Appendix I)

APPENDIX I

ALPHABETICAL INDEX OF STATEN ISLAND LOCALITIES AND HABITATS

Numbers refer to map, figure 12.

1. Annadale. — Arden to Delmar Aves. between Amboy Road and Richmond Parkway. Lowland oak forest on moraine; some boggy ponds.

2. Arden Heights. — Arden Avenue vicinity between Arthur Kill and Woodrow Roads. Lowland oak forest, partly on moraine, partly on sand. Some oak-birch scrub. Includes mowed meadows at Saint Michael's Home.

3. Arlington. — Railroad yard and vicinity west of South Avenue and north of Forest Avenue. Acid sand, with oak-heath scrub and bunchtop bluestem-switchgrass barrens.

4. Bloomfield. — South Avenue from Forest to Travis Aves. Acid barrens, oak scrub, swamp pin oak forest, acid bogs, mostly on gray sand.

5. Buck's Hollow. — vicinity Rockland and Brielle Aves. Upland oak forest, lowland forest, serpentine barrens atop high hills, vernal ponds and a bog. Metropolis of swamp white and basket oaks.

6. Charleston. — Arthur Kill Road and Kreischer Avenue, east to Pleasant Plains. Glacial yellow sands on Cretaceous clays. Oak-birch scrub, a marsh and limited salt marsh areas.

7. Chelsea. — South Ave. and Travis Ave., south to Arthur Kill Road. Acid sand, bogs, lowland scrub, salt marsh, landfill.

8. Clifton. — Urban area, vic. Vanderbilt and Tompkins Avenues. Formerly vacant lot collecting.

9. Eltingville. — Arden to Richmond Aves. between Woodrow Road and Hylan Blvd. Upland and lowland woods, some old fields, terminal moraine.

10. Fort Wadsworth. — Lily Pond Avenue at Seaside Blvd. Rolling lawns open to the south. Late season *Colias*.

11. Fox Hills. — Between Park Hill Apartments and Hylan Blvd., Osgood Ave. to the S.I. Expressway. Serpentine-limonite barrens; terminal moraine; waste ground; ponds.

12. Graniteville. — Diabase quarry on Forest Ave. opposite end of Simonson Ave. Scrub vegetation and marsh. Lowland brush and waste ground spotty south along Richmond Ave. to Jules Drive. Swamp forest in Baron Hirsch Cemetery.

13. Great Kills. — Hylan Blvd. from Emmet to Fairlawn Aves. Beach, goldenrods and asters, hydrofill with reeds.

14. Huguenot. — Hylan Blvd. to Woodrow Rd. between Delmar and Seguine Aves. Lowland oak forest with boggy ponds; birch-sassafras-oak scrub.

15. Latourette Park. — Rockland Avenue near Forest Hill Road. Serpentine uplands with bluestem barrens.

16. Mariner's Harbor. — Morningstar Road to South Ave. from Richmond Terrace to Forest Ave. Urban area with vacant lots, some landfill; acid sand; marshes and railroad tracks.

17. Midland Beach. — Seaside Blvd. between Miller Field and Vulcan St. Beach, thickets, vacant lots, reeds on landfill.

18. New Dorp. — Hylan Blvd. south to the sea, Ebbits St. to Elm Tree Ave. Beach, thickets, vacant lots, landfill.

19. New Springville. — Richmond Ave. near Richmond Hill Road. Extensive landfill and waste ground; salt marsh; upland woods.

20. Oakwood. — Hylan Blvd. to the sea from Ebbits St. to Emmet Ave. Lowland woods, salt creeks, reeds on hydrofill, beach.

21. Old Place. — Waste ground and salt marsh, vic. base of the Goethals Bridge.

22. Pleasant Plains. — Hylan Blvd., Seguine Ave. to Richard Ave. Lowland forest, boggy ponds, acid scrub. Terminal moraine. Damp meadows at Mount Loretto.

23. Port Ivory. — Richmond Terrace near Western Avenue. Extensive vacant lots and waste ground, mainly on landfill.

24. Port Richmond. — Morningstar Road to Jewett Avenue from Richmond Terrace to Forest Ave. Urban area with vacant lots and waste ground.

25. Richmondtown. — Arthur Kill Road at Old Mill Road. Upland serpentine barrens.

26. Richmond Valley. — Drumgoole to Hylan Blvds., Mount Loretto to Page Ave. Acid lowland woods and scrub; boggy ponds.

27. Saint George. — Richmond Terrace and Bay Street to Brighton Avenue and Jersey Street. Urban area with railroad yard, waterfront, vacant lots, some exposures of serpentine.

28. Sea View. — vic. Bradley and Brielle Aves. Upland woods, some scrub, waste ground, old fields, serpentine barrens.

29. Silver Lake. — Forest Avenue at Victory Blvd. Mowed meadows and much-disturbed upland woods.

30. South Beach. — Seaside Blvd. from Lily Pond Ave. to Vulcan St. Beach, vacant lots, reeds on landfill.

31. Stapleton. — vic. Bay Street from waterfront to Ward Hill. Urban area; waterfront; vacant lots; extensive exposure of serpentine vic. Swan and Homer Sts.

32. Todt Hill. — Richmond to Manor Roads between S.I. Expressway and Todt Hill Road. Upland forest, marshes, scrub, serpentine-limonite barrens.

33. Tottenville. — Hylan Blvd. to Arthur Kill Road, south of Page Avenue, Acid scrub, lowland forest, hackberry thickets, beach.

34. Travis. — Travis Ave. from Richmond Ave. to Victory Blvd., south on Victory to end. Acid sand, lowland scrub, marshes and landfill.

35. Watchogue. — vic. Willowbrook Expressway near Lambert's Lane. Lowland forest, formerly extensive acid-sand barrens.

36. West New Brighton. — vic. Broadway from Castleton Ave. to Richmond Terr. Urban area with vacant lots.

37. Willowbrook. — Richmond Avenue near Victory Blvd., east to Willowbrook Road. Swamp forest, boggy areas, old fields.

38. Wolfe's Pond Park. — Hylan Blvd., Cornelia Avenue to Holton Ave. and south to Lemon Creek estuary. Lowland forest, bog, ponds, salt marsh, beach.

39. Woodrow. — Arthur Kill Road to Woodrow Road from Huguenot Ave. to Bloomingdale Road. Deep yellow acid sand with oak scrub, pine barrens relicts, bogs.

APPENDIX II

SOME CLIMATOLOGICAL AND PHENOLOGICAL ASPECTS OF THE 1971 SEASON

The phenology of any organism represents a profound adaptation to its environment. Natural selection adjusts developmental rates in response to a variety of factors in the physical and biotic environment. The characteristic spring larval period of univoltine oak-feeding Holarctic insects, particularly Lepidoptera, apparently, represents an adaptation to the phenology of tannin production in the leaves of the host (Feeny, 1970). It is noteworthy that the phenology of adult emergence in oak feeders has been dictated by other factors, since early- and late-winter Noctuids and Geometrids, very early spring Hesperiids, and midsummer Theclines, to name a few familiar examples, all have spring-feeding larvae. In some cases, phenological adaptations clearly entail the surrender of reproductive potential. The latent polyphenism of *Pieris virginiensis* is a strong argument for its univoltinism being derivative from a multivoltine *napi*-group ancestor; the phenology is closely correlated with that of the host plant, *Dentaria* (Shapiro, 1971a). In most cases butterfly phenology is certainly correlated with climate either directly, or indirectly, through the condition of the host. Among the determinants of phenology and brood sequence, the following may be predicted:

1. Developmental response to weather in a given season must be tightly enough controlled throughout the population to provide for synchronous availability of males and females. Countering this pressure toward standardization of response is the likelihood that absolutely standardized populations would be wiped out in very unusual years, a "group-" or "interdeme" selection argument that would favor the maintenance of some diversity of response. The level of diversity resulting from these conflicting pressures should be determined by the long-term predictability of the environment. Theoretically, the largest potential for genetic diversity of response should be found in populations inhabiting environments with normally high serial correlations but which occasionally produce critically wide deviations from the norm (e.g., late freezes).

2. Generation time and the number of broods per year must be set so as to allow the progeny of the last brood to enter the proper life-history phase (or physiological condition) to survive the adverse season. Since the onset of adverse conditions (e.g., freezes) is variable from year to year, the onset of diapause must be conservative; that is, in many or most years conditions may remain favorable well beyond the time of the onset of diapause, perhaps even permitting an additional generation if part of the population does not diapause. (We have examined the phenology of diapause onset in *Pieris* as related to the variance in the onset of freezing weather at different localities; these data will be presented elsewhere.) If diapause is strictly regulated, then, some reproductive potential is lost in some seasons. In colonizing species with high reproductive rates ("r" species, MacArthur and Wilson, 1967) control of diapause is probably more variable, allowing part of the population to "gamble" against the weather. "Partial" or "false" broods of butterflies probably represent a mixture of such adaptive strategies with developmental accidents. In some cases, the action of natural selection in "standardizing" diapause can be inferred (Shapiro, 1970).

3. The physiological control of diapause onset is normally tied to photoperiod, which is in middle latitudes a much more reliable seasonal predictor than temperature. The breaking of diapause and the control of subsequent development are subject to different pressures since, in addition to predicting the improbability of further adverse weather, they must produce insects synchronously with the availability of host plants. Many diapausing insects require a minimum exposure to low temperatures before resuming development. In general, diapause terminates well in advance of emergence, and the intervening development is temperature-dependent, at least for spring species. Natural selection has probably brought the sensitivities of host plant bud burst and insect emergence into very close agreement; in some cases (e.g., *Erynnis brizo*) the insect emerges prior to host bud burst (*Quercus ilicifolia*, a very late species to leaf out and very subject to frost damage) but does not oviposit until the plant is in suitable condition, but this is exceptional.

4. In general, dates of emergence of multivoltine species and of most univoltine spring species will be earlier as one progresses from cooler to warmer climates, tending to reflect the date of onset of similar weather conditions. Thus *Pieris rapae*

Table 2. Composition of northeastern butterfly faunas by family.

Family	Tinicum-Eastwick	Staten Island	Dist. of Columbia	Central N.Y.	Del. Val.	Va.
Satyridae	4	5	4	5	7	8
Danaidae	1	1	1	1	1	1
Heliconiidae	1	1	-	-	1	1
Nymphalidae	16	22	20	26	26	26
Libytheidae	1	1	1	-	1	1
Riodinidae	-	-	-	-	1	2
Lycaenidae	7	17	13	21	24	20
Liphyridae	-	1	1	1	1	1
Papilionidae	5	6(7)	7	5	6	7
Pieridae	8	8(9)	8	8	9	16
Hesperiidae	30	42	37	38	51	63

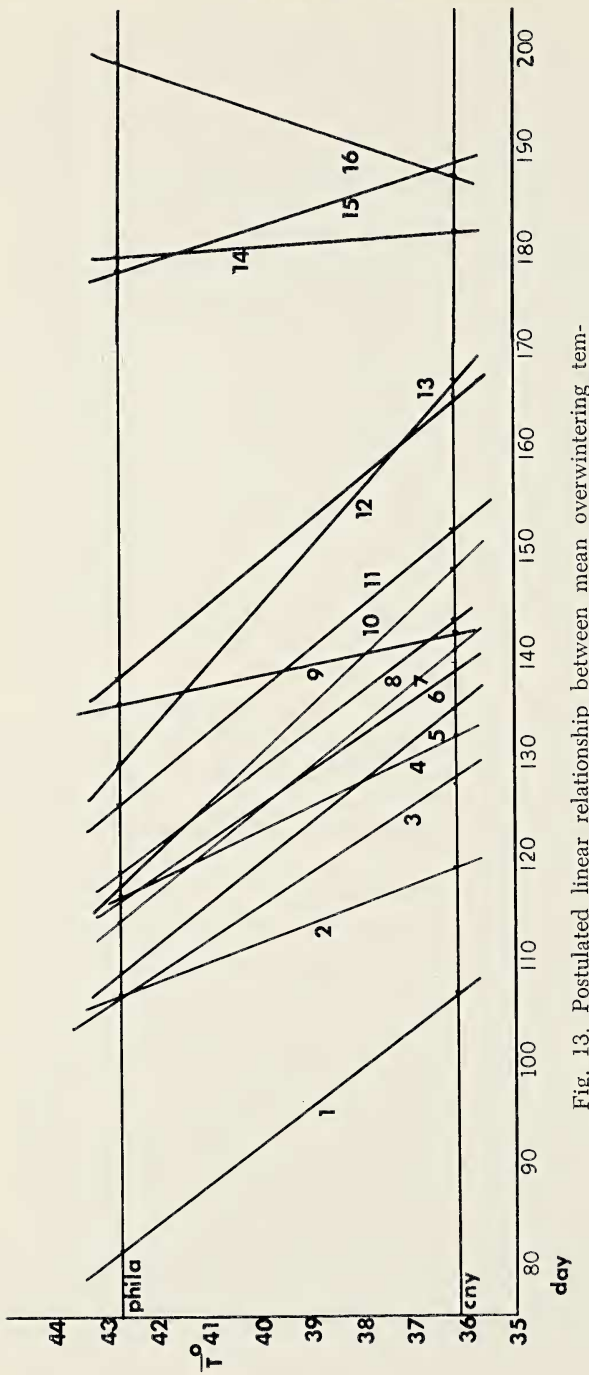

Fig. 13. Postulated linear relationship between mean overwintering temperature and mean first flight for 16 common species, based on Philadelphia and central New York data. Note the high average "sensitivity" of spring species to temperature, as indicated by the gentle slopes. Key: 1. *Pieris rapae*; 2. *Lycaenopsis argiolus*; 3. *Erynnis juvenalis*; 4. *Colias philodice*; 5. *Papilio polyxenes asterius*; 6. *Everes comyntas*; 7. *Colias eurytheme*; 8. *Phyciodes tharos*; 9. *Lycaena phlaeas*; 10. *Papilio glaucus*; 11. *Pholisora catullus*; 12. *Polites peckius*; 13. *Epargyreus clarus*; 14. *Cercyonis alope*; 15. *Satyrium falacer*; 16. *Poanes viator*.

ecloses in late February in the Sacramento Valley of California under a temperature regime substantially identical to that in late March-early April in the northeast, its usual emergence time there. Midsummer univoltines tend to be insensitive to temperature gradients, unlike spring species (Fig. 13). The one widespread non-migratory late summer-autumn univoltine, *Hesperia leonardus*, emerges later southward and downslope, again reflecting the onset of similar weather (mean first dates: central New York, viii.14 (day 227); Philadelphia, ix.8 (day 252)). This tendency was also noted by Clark (1932).

Knowledge of the phenology of animals in general, with the exception of migratory birds, is very poor and this is certainly true of the northeastern butterflies. Since 1958, one of us (AMS) has been gathering phenological data on common, widespread butterfly species in the northeast; such data are now available for Philadelphia, Pennsylvania (1958 through 1966 seasons) and central New York (as defined in Table 1, this paper) (1967 through 1970 seasons) and for the climatically unusual 1971 season at Staten Island, New York. Both the central New York and Philadelphia data embrace wide between-year variances in temperature, precipitation, and per cent sunshine, and while the sampling intervals are not as long as might be desired, they are probably fairly representative. In central New York, the spring of 1967 was much colder than normal and all emergence dates were from one to four weeks later than in 1968-70, which years were closely matched for most species. A detailed treatment of these data will be published elsewhere; the purpose of their introduction here is an attempt to analyze the probable deviation from normal of the 1971 season on Staten Island.

The 1971 Season at New York

Table III shows the 30-year means for maximum, minimum, and monthly temperatures, rainfall, and per cent sunshine at Central Park Observatory, New York City, and the 1971 figures for the same parameters of climate. Many of these values are deceptive because the within-month variance in temperature was higher than normal in both spring and fall, 1971. The general picture, however, is of a cool late winter and spring, an extremely wet summer, and a mild but cloudy autumn. Since only 1971 emergence data are available, is it possible to determine whether these conditions distorted the apparent flight periods of Staten Island butterflies?

Month	Temperature						Precipitation		Pct. of Possible Sunshine	
	Daily Maximum		Daily Minimum		Monthly					
J	39.5	(33.1)	26.9	(20.8)	33.2	(27.0)	3.31	(2.67)	51	(57)
F	40.3	(40.4)	26.4	(29.8)	33.4	(35.1)	2.84	(5.33)	55	(46)
M	47.8	(46.8)	33.2	(33.4)	40.5	(40.1)	4.01	(3.80)	57	(54)
A	59.6	(59.9)	43.1	(41.6)	51.4	(50.8)	3.43	(2.95)	59	(68)
M	71.4	(70.0)	53.4	(52.7)	62.4	(61.4)	3.67	(4.24)	62	(49)
J	80.2	(82.9)	62.5	(65.5)	71.4	(74.2)	3.31	(2.31)	65	(63)
J	85.3	(85.8)	68.2	(69.8)	76.8	(77.8)	3.70	(7.20)	65	(62)
A	83.3	(84.2)	66.8	(67.6)	75.1	(75.9)	4.44	(9.37)	64	(70)
S	76.8	(77.3)	60.1	(65.8)	68.5	(71.6)	3.87	(7.36)	63	(40)
O	66.3	(69.1)	50.3	(56.2)	58.3	(62.7)	3.14	(4.14)	61	(45)
N	53.7	(50.8)	40.3	(39.4)	47.0	(45.1)	3.39	(5.64)	52	(45)
D	42.1	(47.1)	29.7	(34.5)	35.9	(40.8)	3.26	(1.76)	50	(42)

Table III. Normals and 1971 values (in parentheses) for climatic parameters, Central Park Observatory, New York. (Local Climatological Data, 1971 Annual Summary, U.S. Dept. of Commerce, National Climatic Center.)

An attempt has been made to estimate mean first flights of selected common, widespread species by assuming a linear relationship between mean temperature during the adverse season and mean spring emergence dates. Lines have been drawn for each species using day of the year as the abscissa and mean temperature between October 1 and May 1 as the ordinate, plotting temperature data for central New York and Philadelphia (Table IV) with their corresponding flight dates and noting the date-intercept of the line at New York City mean temperatures (Fig. 13). The results, including predictions of mean first flights at New York, are given in Table V where they are compared to observed 1971 values. It should be clear from the preceding section that these predictions represent extremely crude approximations. (Considerably more reliable estimates may be obtained by analysis of the pattern of onset of warm weather in spring, as noted for *P. rapae* in the previous section.) They do, however, show a definite trend: of 16 species all but 4 emerged later than the predicted date, which would be expected given a cool spring. Field trips to other parts of the northeast confirmed a general lateness of the 1971 season, which reached its extreme in central New York where *Incisalia niphon* was still flying vii.7 and *Satyrium falacer, liparops, caryaevorus,* and *acadica* and *Harkenclenus titus* were all still flying viii.22—four and three weeks late, respectively.

The four "early" emergents at New York show no particular life-history attributes in common. *Poanes viator* (and *Cercyonis alope,* which was "late") should probably be discounted since different subspecies are involved, feeding on different hosts (Shapiro, 1971).

The very heavy rainfalls of July through November had little visible effect on flight periods, perhaps because temperatures and levels of cloudiness were not unusual during most of the period. Some carryover may, however, occur in 1972. The most striking impact of the rains seemed to be the abundance of extreme "wet" forms of *Precis coenia* on the inundated south shore. This condition was not observed in the dry 1970 season. The environmental control of pigmentation in *P. coenia* has not been investigated experimentally under well-controlled conditions.

In general, we would predict that mean first flights for most or all spring species on Staten Island should be five to fifteen days earlier than observed in 1971. These estimates are con-

Month	Mean Monthly Temperatures	
	Philadelphia, Pa.[a]	Central New York[b]
J	33.2	26.4
F	33.6	25.7
M	42.3	33.7
A	51.6	45.1
M	63.1	57.3
J	72.1	67.1
J	76.3	71.9
A	74.0	69.8
S	67.7	62.6
O	56.6	52.1
N	45.9	40.3
D	35.9	29.1
Mean Temp., Oct. 1 - May 1[c]	42.7	36.1

[a]Climates of The States, Pennsylvania, 1960, USWB, Dept. of Commerce. Philadelphia International Airport Station.

[b]Climates of the States, New York, 1960. Summary for Central Lakes Division.

[c]Value for New York City: 41.9.

Table IV. Climatological data used for prediction of flight periods. (See text.)

sistent with the close climatic similarity between Philadelphia and Staten Island.

Number of Broods

The mechanism of switching from one number of generations per year to another is poorly understood and has received very little attention, but it is presumably a threshold phenomenon. The transition may be associated with "partial" broods, a common phenomenon in butterflies perhaps reflecting diversity in the genetic control of diapause. In very few cases are sufficient data available to construct a phenological map for a species and attempt climatic correlations. Two striking cases where this may be possible are the skippers *Polites manataaqua* and *Euphyes ruricola metacomet,* both of which are apparently univoltine on Staten Island but bivoltine at Philadelphia and in southern New Jersey. That the environmental control of flight periods may be quite complex, however, is suggested by the central New York flight data on *P. manataaqua*—which seems partially double-brooded at Ithaca but not in the nearby hills. The impact of phenological isolation of colonies on gene flow among them is a subject needing study. Striking phenolgical differences have been observed between conspecific populations of several butterflies in the Sacramento Valley and the narby Vaca foothills, California.

Associated with changes in brood sequence are changes in the biology of overwintering. Species of *Vanessa* and *Nymphalis* overwinter frequently in the pupa at Philadelphia but rarely or never in central New York. Spring flights at Philadelphia consist of a mixture of fresh and worn individuals, but in all the species concerned mating does not occur until spring. Hibernators may, however, mate and oviposit up to three or four weeks earlier than emergents and the amount of gene flow between the two groups is not known. In *Polygonia* spp. mating occurs in the fall (and perhaps again in spring), and no overwintering by pupae is known anywhere.

The seasonal sequence in *Lycaenopsis argiolus,* as discussed under that species, is the most unusual of any of our butterflies. Although genetic factors are clearly implicated in the polymorphism of pattern, pupal diapause seems to be under environmental control at least in part, and the basis for the "skipping" of spring flights at Tinicum (regularly) and Staten Island (1971)

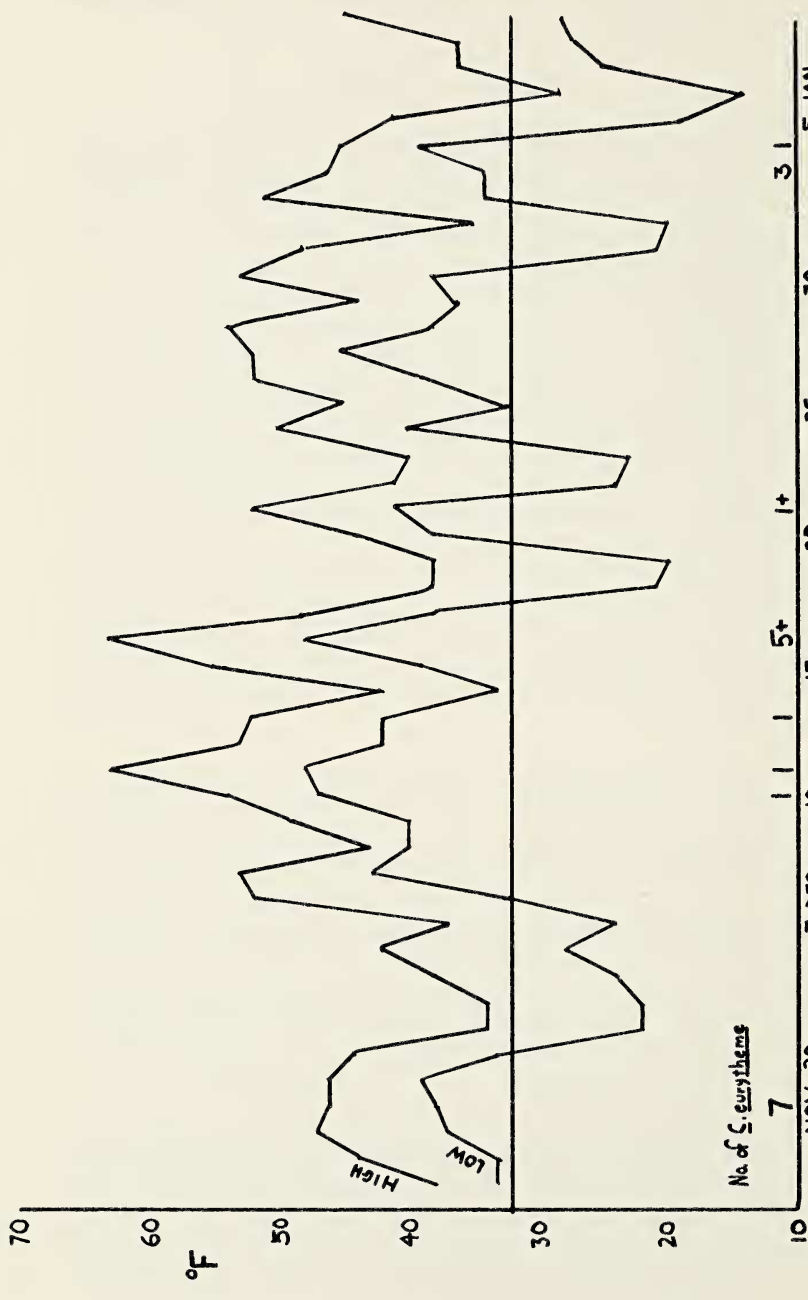

Fig. 14. High and low temperatures and *Colias* collections, early winter 1971-72, Staten Island, N.Y.

	Mean First Dates		Predicted Mean First Date New York City	Observed First Date New York City 1971	Deviation
	Philadelphia, Pa. 1958-1966	Central New York 1967-1970			
Phyciodes tharos	iv.27 (118)	v.22 (143)	iv.30 (121)	iv.21 (112)	(+9)
Satyrium falacer	vi.25 (177)	vii.7 (189)	vi.26 (178)	vii.2 (184)	(-6)
Lycaena phlaeas	v.14 (135)	v.22 (143)	v.15 (136)	v.10 (131)	(+5)
Everes comyntas	iv.25 (116)	v.18 (139)	iv.28 (119)	v.11 (132)	(-13)
Lycaenopsis argiolus	iv.16 (107)	iv.28 (119)	iv.18 (109)	v.14 (135)	(-24)
Colias eurytheme	iv.23 (114)	v.19 (140)	iv.28 (119)	v.5 (126)	(-7)
Colias philodice	iv.25 (116)	v.11 (132)	iv.27 (118)	iv.24 (115)	(+3)
Pieris rapae	iii.21 (81)	iv.16 (107)	iii.26 (86)	iv.11 (102)	(-16)
Papilio polyxenes asterius	iv.18 (109)	v.13 (134)	iv.21 (112)	v.5 (126)	(-14)
Papilio glaucus	iv.26 (117)	v.23 (144)	iv.30 (121)	v.17 (138)	(-17)
Epargyreus clarus	v.8 (129)	vi.16 (168)	v.13 (134)	v.26 (147)	(-13)
Pholisora catullus	v.4 (125)	v.30 (151)	v.7 (128)	v.17 (138)	(-10)
Erynnis juvenalis	iv.16 (107)	v.6 (127)	iv.18 (109)	v.5 (126)	(-17)
Polites peckius	v.17 (138)	vi.14 (166)	v.21 (142)	v.27 (148)	(-6)
Poanes viator ssp.	vii.16 (198)	vii.6 (188)	vii.15 (197)	vii.2 (184)	(+13)
Cercyonis alope ssp.	vi.27 (179)	vi.30 (182)	vi.27 (179)	vii.2 (184)	(-5)

Table V. Mean dates of first flight for selected species at Philadelphia and Central New York; predicted first flights at New York, assuming a linear relation between overwinter temperature and emergence date; and observed first flights at New York in 1971, with deviations from prediction. (See text.)

remains unknown: it is, however, striking that the habitats for the species are so similar in the two areas.

The winter 1971-72 flight of *Colias eurytheme*

The most unusual aspect of the 1971 season was the prolongation of the flight period of the orange sulphur some four weeks beyond normal, into early January at New York and mid-January at Philadelphia. *C. eurytheme* is normally the last non-hibernator on the wing in autumn. Its mean disappearance date averages four weeks after the first frost or roughly after the accumulation of 45 degree-days below freezing (Shapiro, 1962, 69, 70). In 1971-72 these figures were eight weeks and 120 degree-days. The abnormal *sequence* of climatic events probably accounts for these departures. The extraordinary 1971-72 flight can be tentatively ascribed to the following conjunction of events:

1. *Cool, wet, and cloudy weather in November.* The production of a "false brood" in late autumn depends on the timing of the development of mid-autumn immatures. Most of the overwintering at New York is by larvae, and after mid-November conditions are unfavorable for pupation. A reservoir of pupae is generally available in early November; these either eclose as a "false brood" toward the end of the month or early in December if the weather is favorable, or die without eclosing by early winter. November, 1971 averaged 1.9°F below normal and had 5.64 inches of rain, an excess of 2.25, with measurable rainfall on 11 days. We hypothesize that these conditions delayed the pupation of some individuals, and the development and eclosion of pupae already formed, resulting in a larger-than-normal reservoir of pupae available for eclosion later in the season. Pupal mortality due to cold was probably negligible in November since no sub-freezing temperatures occurred.

2. *Failure of cold weather in December.* There were 12 freezes in December, six being in the first week. These represented the first outbreak of arctic air of the season. Data from previous years (Shapiro, 1970) show that conditions of the sort prevailing December 1-6, 1971 do not seriously affect *Colias* populations unless sustained longer. The remaining six freezes were very scattered through the month and there were no days in December on which the temperature remained continuously below freezing; after the sixth, the lowest daily maximum was 38° on

the 18th and 19th, and every other day was above 40°. These minimum-temperature conditions are comparable to November in normal years and do not prevent the subsequent production of a "false brood." The accumulation of a large number of degree-days below 32° was possible in 1971-72 because they were distributed in an autumn, rather than a winter, pattern.

3. *High temperatures in December.* December averaged 4.9° above normal. It was characterized by periods of cloudy, mild weather—conditions suitable for development of pupae, but not flight of adults—followed in each case by one or two sunny and very warm days on which eclosion and flight occurred. Mortality of adults due to cold was probably also low; a worn, fertile female was taken on December 16. This pattern remained intact into mid-January. There were no flight days between December 21 and January 3, but on the latter date fresh individuals were present in numbers at Fort Wadsworth, S.I. The last New York capture was a fresh female taken at rest in overcast early on the morning of January 4 at Port Richmond.

The end of the flight. — Even given the protracted nature of the 1971-72 "false brood," it seems unlikely that the supply of pupae was exhausted before the emergence was halted by cold-induced mortality. On January 6, for the first time in the season, the temperature never exceeded 32°. Warm weather returned January 10 and persisted, with overcast through the 11th yielding to considerable sunshine and very high temperatures on the 12th and 14th. This cloudy-mild becoming sunny-warm pattern had produced flights on each prior occasion. On January 12, we were at Erdenheim, Montgomery Co., Pennsylvania (suburban Philadelphia) and collected 25 *Colias,* all fresh, at the locality mentioned in Shapiro (1969). No *Colias* were seen on January 14 on Staten Island, perhaps because gusty northwesterly winds kept any new emergents down. A cold wave arrived late on January 14 and minima of 10°, 5°, and 10° were set on January 15-17; the mean for January 16 was 10°. No flight has ever been observed after such low temperatures. The mild pattern reasserted itself later in January for several days. We were afield on a potential flight day, January 24, but saw no butterfly activity.

Clark and Clark (1951) record *C. eurytheme* flying January 27, 1947 in Virginia. The last week of January, 1947 set weather records over the entire northeast, with 60's and 70's north to

New England. Unfortunately, no other collections were reported. In 1947, as in 1971, freezes were few and scattered prior to the abnormally warm winter weather. Comparable temperatures with considerable sunshine at Philadelphia in December, 1964 and 1966 and January, 1967 and in central New York in January 1967 failed to elicit *Colias* emergences, but in each case severe cold had preceded the outbreak of warm air.

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